EDITORIAL

AS we move toward the I.T.U. Conference in Geneva next year, Australian radio amateurs are becoming more and more concerned about the fate of their frequency bands, which are certain to be under great pressure from operators of other services seeking fresh allocations.

The amateur bands are decided upon at the I.T.U. conferences to which delegations from all countries are sent to hammer out the full schedule.

Most of the hammering out is done by local administrations before the conference takes place, otherwise it would be impossible to settle such a complicated matter in a reasonable time.

Amateurs are at a big disadvantage when it comes to negotiating for their place in the sun.

In Australia they are not members of any frequency allocation committees and therefore have no vote concerning their own claims. They have no commercial or powerful affiliations which can speak for them. They are virtually at the mercy of other frequency users who are not very interested in amateurs, and who could, in theory at least, vote them out of existence. Some of these overseas users already illegally occupy amateur frequencies.

Their international status puts them in a completely different category from those who use locally allotted frequencies as for small ships, bushfire work and so on. They are, in fact, the only internationally recognised body which has no direct say in its own destiny.

No one knows officially what the Australian position will be at Geneva. But amateurs would be wise to see that their local members of Parliament realise how their frequencies can be prejudiced.

In the long run, the Government and its members will decide what Australia's position will be at Geneva, and in past years we have seen amateurs lose by default possibly because no one was told what might happen.

And once an amateur frequency is lost, it is lost for ever.

The Wireless Institute of Australia has been most active in pressing its claims through every available channel.

As citizens of the land, individual amateurs have the democratic right to do the same.

John Moyle

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RADIO ★★ TELEVISION AND HOBBIES

A NATIONAL MAGAZINE OF RADIO, TELEVISION HOBBIES AND POPULAR SCIENCE

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Vol. 20 No. 8

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OUR COVER PICTURE

In Berkshire, England, tests are being made to examine the effects of radio activity on crops and the fields which grow them. Workers use protective clothing during the tests.

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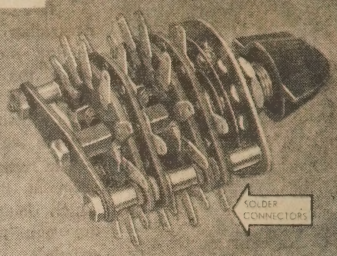
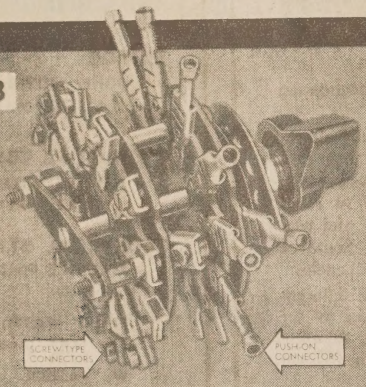


TYPE B



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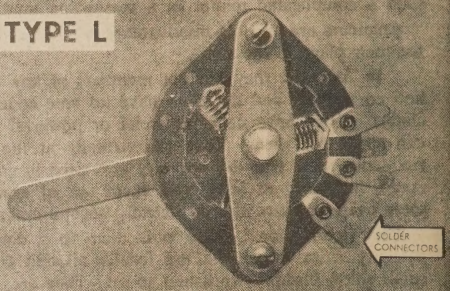

TYPE A: Standard type with Copper Lugs. RATING 10 A. 250V AC.

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SINGLE OR MULTI SECTION (from 1 to 20 sections):

POLES AND POSITIONS PER SECTION:

1 pole max. 12 positions
2 Pole max. 6 positions
3 Pole max. 4 positions
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INSTRUMENT SWITCHES. The type B/S. because of its low **silver to silver** contact resistance, is particularly recommended for such equipment as Decades, Bridges, Pyrometry, etc.

THE PATON ROTARY SWITCH IS NOW BEING FITTED TO APPLIANCES such as: Radiators, Washing Machines, Air Conditioning Equipment, Battery Chargers, Cinema Equipments, Fans, Radio and Television, etc., etc.

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SMALL DIMENSIONS:

TYPES A and L—overall diameter 2 inches

TYPES B and B/S—overall diameter 2¾ inches.

LOW CONTACT RESISTANCE:

TYPES A., L. and B—800 Micro ohms. average.

TYPE B/S—400 Micro ohms. average.

LOW CAPACITIVE LOSSES: Less than 1 Pico farad between contacts and to earth (suit U.H.F.).

ENDURANCE: Our special **Life Test Apparatus** has subjected Switches to many thousands of oscillations at **Maximum rated Load** without appreciable deterioration.

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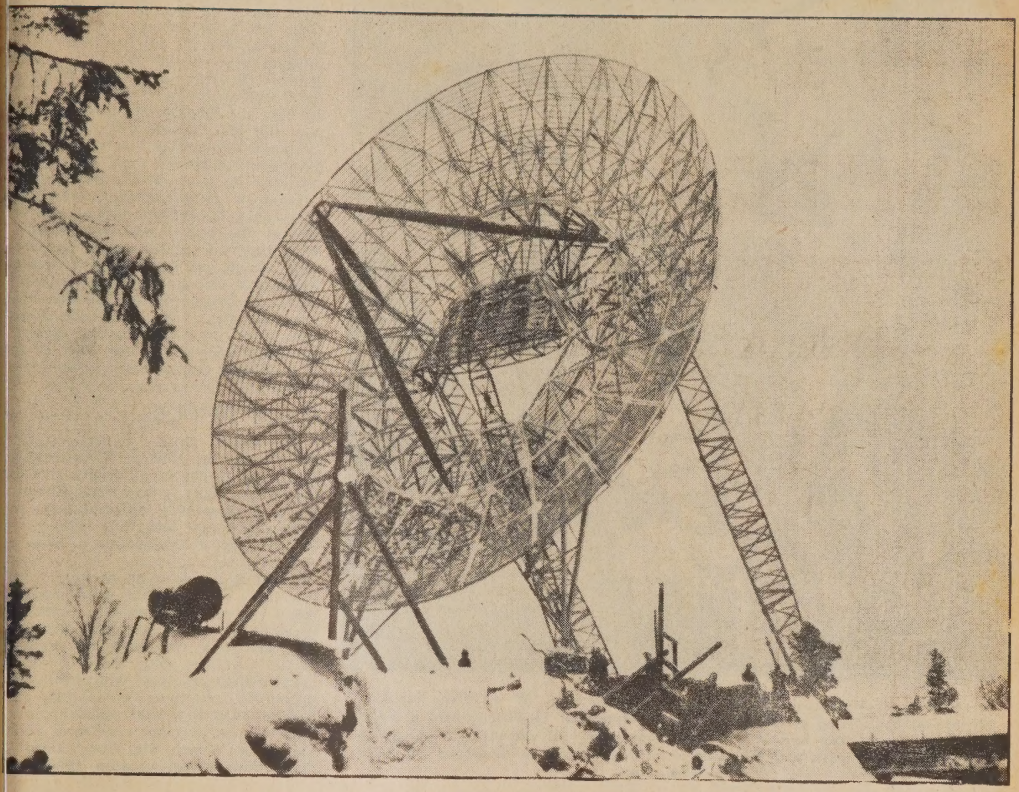
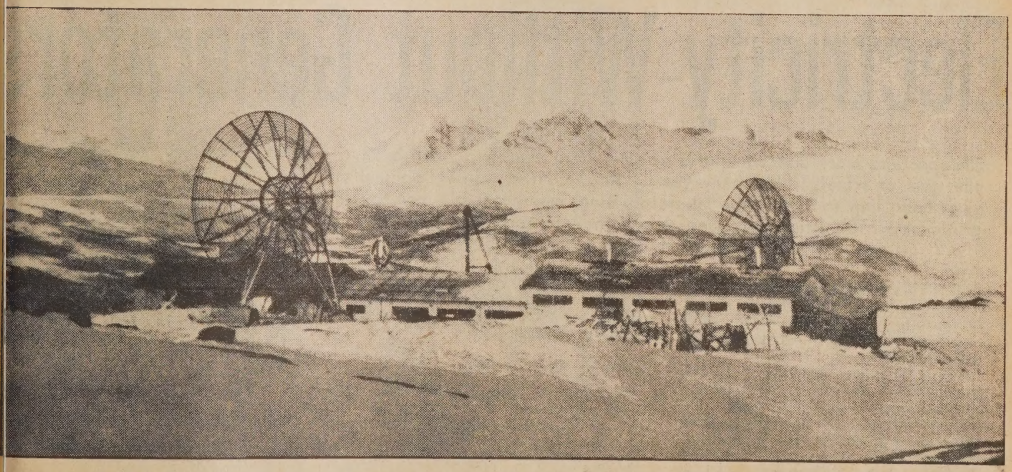
FORWARD SCATTER IN EUROPE





First link in a chain of forward scatter stations which will link Norway with Turkey was handed to NATO last August. It marks just 500 miles of system starting at Bodoe. These station views show the 60ft antenna systems.
(Story page 13.)

Dr. George N. Hatsopoulos (left) and Dr. Joseph Kaye of the Department of Mechanical Engineering at the Massachusetts Institute of Technology hold a model of a new device they have invented for converting heat directly into electricity. It has no moving parts and the inventors believe it can be developed for many practical uses.

Electricity-Without Generators

Cheaper and more direct methods of generating electricity have been the goal of scientists for many years. Recent intensive development gives hope that some of these laboratory ideas may eventually become practicable. This article describes some of the latest and most promising of these.

A LANKY young M.I.T. professor sketches a vacuum tube on a pad. Eyes sparkling confidently, voice softly accented by his native Athens, he describes tomorrow:

"This is a power package. Just a tube—maybe as big as an old-fashioned radio tube—and a source of heat. No steam, no turbine, no generator. Plug in the tube and out comes electricity—a thousand watts!

"We can even build the heat inside the tube. A radioactive capsule the size of a pencil eraser would throw off heat enough to make it work."

In laboratories around the world, scientists are perfecting radical new ways to produce electricity—ways that will save money and natural resources, add convenience and make long-cherished dreams come true.

THINGS WE'D LIKE

Would you want a silent car with all the engineering advantages of electric drive plus the beauty of its own electric source under the hood?

Even a quiet, self-powered, electric lawn mower "would be a boon," remarks one scientist in the staid pages of the "Proceedings" of the Institute of Radio Engineers.

How about a table-top electric plant for farmhouses? Or a still smaller one for camping trips? A TV set runni off a kerosene lamp or propane torc And more significant than these delig ful devices: The efficiency of utiliti big central stations can be raised—pe haps even doubled—to assure cheap a plentiful electricity at your outlets.

The power-plant-inside-a-vacuum-tu exists now. Dr George N. Hatsopoul —the ink is hardly dry on his Doct of Science degree, but he is already assistant professor at M.I.T. and pre dent of the Thermo Electron Engine ing Corporation—has built several. Th are not just laboratory curiosities. Th pour out real current, efficiently.

Equally important, other scienti have done much the same thing.

In the big General Electric Resear Laboratory, mild-mannered, grey-hair Dr Volney C. Wilson displays his v sion of the heat-to-electricity tube. looks much like Hatsopoulos', but wor with cesium gas, instead of a vacuu Upstairs in the same building, big, jov James E. Beggs has still another ty There on Beggs' lab. bench sits a p pane torch, its flame playing against ceramic-and-metal vacuum tube the si of a shilling. The tube is generating ele tricity.

OTHER METHODS

And there's more. Experts on sen conductors—the stuff in transistors—a also building heat-to-electricity and su light-to-electricity converters. Chemis taking a completely different tack, p duce electricity—very, very efficiently from the direct combination of hydrog and oxygen.

It all adds up to an exciting pictu of a new era in power production, t result of several nearly simultaneo breakthroughs in scientific discove You see it in the confident optimi of the scientists. You sense its impo ance in their chariness with details, th occasional refusal to say anything. T is Something Big, vital militarily, wo millions commercially. (Was it Hat poulos or Wilson who first hit on t trick that makes vacuum tubes gu power? A patent fight may be brewi here.)

Decline of the dynamo? For thr quarters of a century the world's el tricity has come from a mechani device: a bundle of wires spinning ins another bundle of wires, the moveme of one relative to the magnetism of other forcing electrons to move. B teries are important, sure, but only wh plugging into a dynamo is not feasible

There's nothing wrong with dynam as machines. They pump out rivers amperes, high voltage or low, AC DC. They last a long time, are hig efficient.

The trouble is driving them. You water power (the money those da cost!). Or you go all around the ba dig up coal, burn it to make steam, the steam spin turbines, finally get turbines to drive the dynamos. (Ato fuel does not help much: you sim burn uranium or deuterium instead coal, at higher cost.) Thanks to int

e engineering this involved coal-am-turbine-dynamo system can pro-ce electricity remarkably cheaply (a v tenths of a cent per kilowatt-hour) d efficiently (40 per cent—very high r a heat system). It can be improved rther, but not much.

There are dozens of simple ways to njure up electrons, even if you don't unt scuffing shoes on the rug or har-ssing electric eels. All (including the citing "new" ideas) have been tried. one ever panned out—until now. What anged the picture was new knowledge atoms, molecules and crystals, and of e way they let go of their electrons.

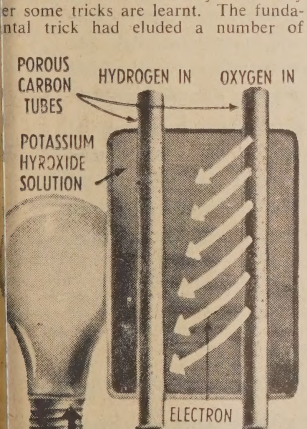
You have heard of the thermocouple. is a loop of two different wires joined their ends. Heat one joint, cool the ner, and electricity flows.

It just barely works: minute currents, s than 1 per cent efficiency. Still it useful for instruments, and Bell Tele-one is trying out a battery of the things power a transistor amplifier (the uples are woven into mats and deliver e watt for a year on a single tank of ttled gas; the whole works—gas tank cluded—fits inside a hollow steel tele-one pole). The Russians use the same a for a kerosene-powered radio. It's joke; they put thermocouples in the rosene-lamp chimney.

ASIC DIFFICULTY

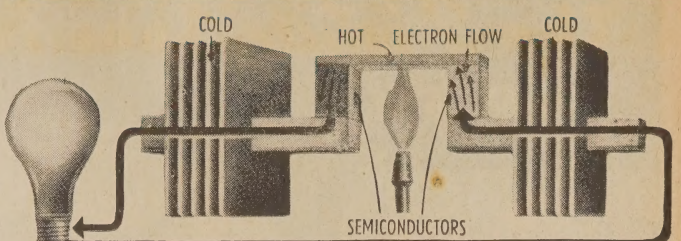
A basic defect cripples thermocouples: etals conduct heat too well. It's diffi-lt to keep the hot end from warming the cold end—and the temperature ference is what makes the thing work. Hatsopoulos pondered this while a enager in wartime Athens (he was ilding radios secretly in his cellar for Greek underground). Why not build thermocouple having part of the loop a vacuum? Little heat could cross the cuum.

This kind of "thermocouple" is a ode, the two-element vacuum tube ndard in radio work. It can indeed nvert heat into electricity—but only er some tricks are learnt. The funda-ntal trick had eluded a number of



hemical combination of hydrogen and ygen to form water releases electrons r electric current. Reaction takes lace at electrodes in electrolyte lution but neither is used up as they e in ordinary chemical battery. Fuel comes from outside cell.

POWER FROM SEMI-CONDUCTORS



Transistor-like semi conductors also convert heat directly into electricity. Two crystals —one doped to be electron rich, the other to be electron poor—are connected and heat is applied to the joint while the other ends are cooled. Military security now cloaks much of this research.

brilliant researchers for decades. It is this:

The diode has to be built backwards. Its electron-emitting element (cathode) must be less willing to give up electrons than the electron-receiving element (anode). Sounds wrong? Energy book-keeping explains why it is right.

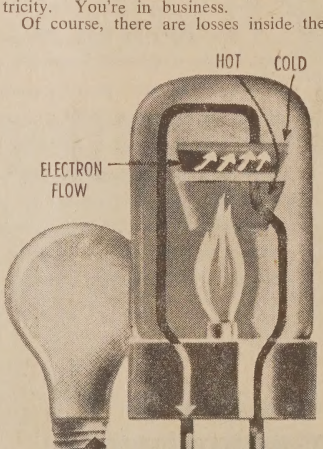
It takes a certain amount of energy —heat, in this case —to boost an electron out of a metal. "Lift it over the top of the wall," physicists say. If the electron falls back into the same kind of metal, it loses as much energy as it had gained getting out. No energy is left over for useful work. You can't make money that way.

But suppose the electron falls back into a different kind of metal, one that has a lower wall (that means a metal more willing to give up electrons, too). Falling this shorter distance, the electron loses only part of the energy it had gained getting over the high wall. The rest of the energy is left over, and can be drawn off as work-producing electricity. You're in business.

Of course, there are losses inside the tube that cut into your profit. The most important is caused by space charge. Electrons emitted from the cathode collect in a cloud near the cathode. Since like charges repel, the space-charge cloud hinders the flow of electrons from cathode to anode.

Hatsopoulos and Beggs get around space-charge by placing cathode and anode very close together. The electrons run into the anode before they can be repelled by the space-charge cloud. Building such tubes is difficult — the cathode and anode must be less than a thousandth of an inch apart without touching. But it can be done. (Beggs is an expert at this — he developed the smaller-than-transistor ceramic vacuum tubes.)

Wilson licks space-charge in a different way, by putting cesium inside the tube. The gaseous cesium atoms lose electrons to the cathode, becoming positively charged. These positive ions then neutralise the negative space-charge cloud.



Latest model of Hatsopoulos vacuum tube heat converter achieves 13 per cent efficiency. For experiment heat is supplied electrically. At least two other versions of the same device are being developed in American laboratories.

FUTURE OF CRYSTALS

Anything vacuum tubes can do, solid components can do, maybe better—without the vacuum! Practically all rectifiers in radios and TV sets are now solid selenium or silicon. Solid germanium (transistors) is taking over the amplifying jobs. So it's no surprise to find that semi-conductors will turn heat into electricity.

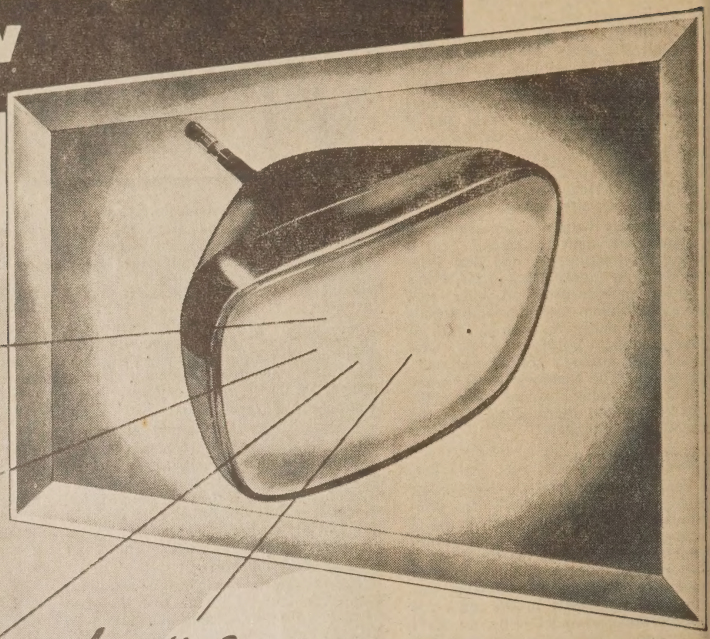
They work like the vacuum tubes. Heat energy shakes electrons loose from their positions in the crystal. The electrons travel to the cold end and go on into new positions, retaining enough energy to perform work as electricity.

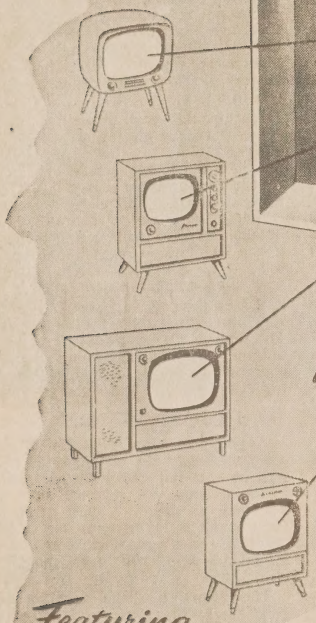
The solid crystals so fertile with electrons are exotic materials like bismuth telluride and lead telluride. But how they blossom with electricity! You can get half an ampere (at very low voltage) from a single bismuth telluride-bismuth unit by keeping the hot end only 36 degrees warmer than the cold end. There's that much temperature difference between the inside and outside walls of your house on a winter day!

Much semi-conductor research is military. Admiral A. M. Morgan has told the United States Congress: "We are on the verge of a break-through . . . which will enable us to get efficiencies comparable to conventional power plants. In submarines, it would eliminate almost all noisy machinery. We should have something definite on this in three years."

The U.S. Navy will say nothing more. But it is common gossip in the industry.

The 'Picture' Tube for TOP TV





In all Good Sets-EVERYWHERE

Yes—that's the truth. Thomas Picture Tubes occupy an honoured place in most well-known TV sets sold in Australia to-day. Just to give you an idea—there are **many, many thousands** of Thomas Tubes giving top service and clear pictures throughout Australia right now.

Thomas Picture Tubes have a manufacturing background of experience that goes back to the beginning of picture-tube history. This long experience not only explains why Thomas Tubes are the first choice of so many famous-name TV set makers, but also proves that their high standards of manufacture are your best guarantee of quality and reliability.

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- ★ Electrostatic Focus
- ★ 90° Deflection
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Thomas Tubes for TV *TOP TV–Always*

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manufactured by
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Thomas PICTURE Tubes

the research contracts amount to
ns of dollars.
e Russians, who have said nothing
vacuum-tube heat converters (or
arine engines), are not reticent
their very high-grade work on
thermoelements. One recent Amer
paper on thermoelectricity cites
s of Russian references. The So
apparently use the solid devices in
Sputniks, and they claim to have
mmercial production an electronic
erator (the solid units work very
in reverse, consuming electricity to
ice heat at one end, cold at the
).
en in the hand-made laboratory
these heat converters look so good
product-development people are
g to get their hands on them.

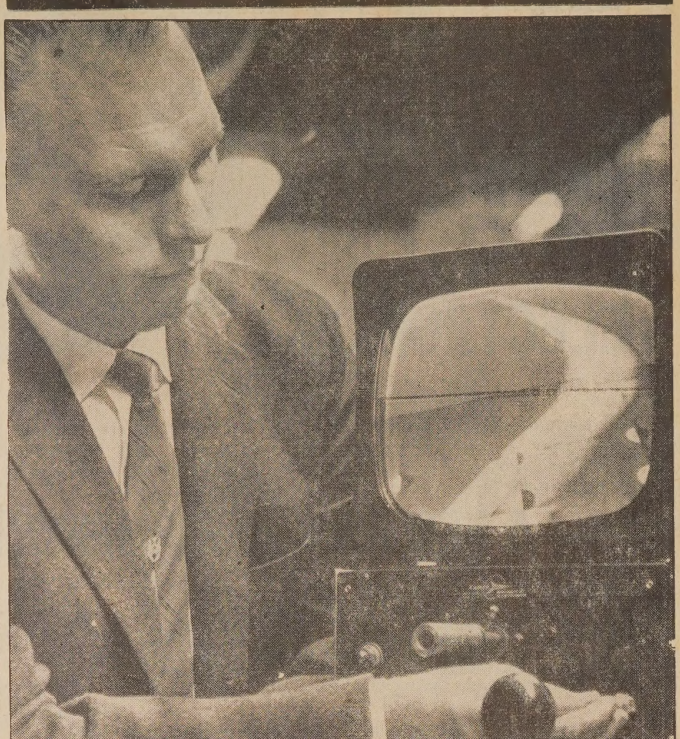
CIENCIES

th the vacuum-tube and solid units
deliver about 10 per cent efficiency
at doesn't sound like much, remem
hat an automobile engine runs only
er cent efficient. It's plenty for job
e you don't mind wasting some
heat, or where heat is a bypro
anyway. For instance:
lent engines for ships, cars, trucks
ower plants for satellites and space
using radioactive heat or sun heat
ntrated by lenses or mirrors.
ompact power sources — for lights
ppliances — burning canned pro-
kerosene, corncobs or buffalo
.
eroplane power plants to utilise the
wasted by jet engine exhausts.
n per cent efficiency isn't enough
xcite utility engineers, who pinch
redths of a penny. But the vacuum-
converter can theoretically achieve
t 40 per cent, as good as the steam-
n dynamo.
fore the converter makes steam
r plants obsolete (if it ever does),
ll help them. It can raise their effi-
y by serving as a "topper."
e direct converter will be built
inside the furnace (coal, oil or
ic) to get first crack at the heat
heat that's left over will make
n. This way you get the converter's
er cent plus steam's 40 per cent of
remainder; an overall efficiency of
er cent. That qualifies as revolu-
ry.

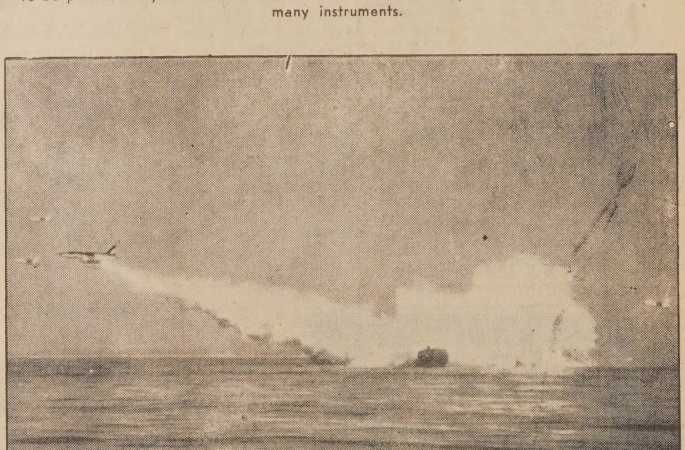
EMICAL CELLS

the time such a super power sta
is built, it may face competition
a completely different source of
icity, the chemical fuel cell.
easy to find chemicals that will
electrons, forcing electricity through
re. That's what happens inside a
ry. In today's batteries, chemicals
acked inside the cell. When they
sed up, the battery has to be re
d (or its chemicals renewed). Soon
will see batteries that get their
ical fuels from outside. They keep
ating power as long as the fuels
coming. Theoretically, efficiency
e close to 100 per cent.
eady one is operating at the Brus-
s World Fair, lighting a panel of
ll-beam lamps. Another is being
ied for the U.S. Air Force.
e fuel cell at Brussels is National
on's, a bundle of porous carbon
in a tank of potassium hydroxide
ygen filters into the tank through
et of tubes, oxygen
set. Oxygen atoms react with the
(Continued on Page 123)

VISUAL PATHWAY IN THE SKY

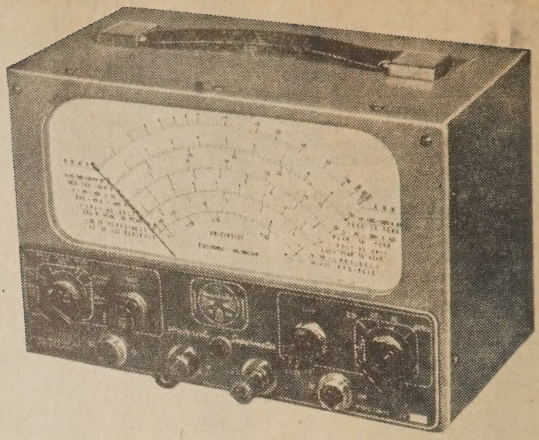


This new navigational aid for aircraft displays the flight path, built up from instrument readings, as a highway with centre line. Line across centre is a permanent horizon—actual horizon (grey tone) shows aircraft here banked slightly to left. Moon-like dots represent terrain and their distance apart the height above ground. The device to be produced by Kaiser Aircraft and Electronics, relieves pilot of the need to watch many instruments.



This Regulus II missile has just been launched for the first time from a submarine. It is 57 ft long, can carry a hydrogen warhead, and flew 200 miles to its target. The three aircraft are chase planes.

FOR T.V. RADIO F.M. ELECTRONICS



This smartly styled University Model TVR/EV Electronic Voltmeter offers many new outstanding features, and is a basic measuring instrument for every branch of electronics. It offers accurate measurement of D.C. voltages, A.C. voltages, very wide resistance ranges, complete dB scales and extended ranges into RF volts.

A NEW V.T.V.M. FOR SERVICE and LAB.

Model TRV/EV.

This V.T.V.M. or as is more commonly known now, Electronic Voltmeter is designed for immediate use in Radio, F.M. and Electronic work and at the same time, is a Television instrument, thus allowing you to buy economically and plan ahead for the tremendous new future opening in this branch of electronics.

This attractive instrument is housed in a grey brocaded steel case with traditional University maroon and silver panel and all control knobs carry clear understandable markings making the instrument simple and effective in use.

A full size sensitive switchboard meter movement is built into the instrument, thus providing an unusually large scale making easier reading and more accurate measurements. The large 8-inch meter face is effectively and beautifully illuminated from the rear and the two colour scale has clear graduations and easy-to-read figures.

Model TVR/EV operates from a 240 volts AC mains and is supplied with instruction booklet, circuit diagram, D.C. voltage probe with inbuilt isolating resistor, A.C. voltage probe, ohms probe and earth lead. Available accessories are a 30,000 volt D.C. probe, a radio frequency crystal probe up to 50 volts at 250 m.c. and a valve probe enabling radio frequency voltages to be read up to 300 volts at 250 m.c.

Truly this is a remarkable instrument, packed into the small size of 10" x 6½" x 5½". You are invited to write for further details.

RANGES :

D.C. Volts Negative, 1-3-10-30-100-300-1000 and with external high voltage probe. 3000-9000-30,000.

D.C. Volts Positive: 1-3-10-30-100-300-1000 and with external high voltage probe, 3000-9000-30,000.

A.C. Volts: 1-3-10-30-100-300-1000.

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Ohms: 0-1000, 0-10000, 0-100,000, 0-1 Meg, 0-10 Meg 0-100 Meg 0-1000 Meg.

RF Volts: 1-3-10-30 (with crystal probe)

RF Volts: 1-3-10-30-100-300 (with valve probe)

DB Ranges: 20 to + 2, + 2 to + 22, + 22 to + 42, + 42 to + 62 (Odb - 1 m.w. in 600 ohms)

Also Centre Zero D.C. Ranges for discriminator alignment.

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Crystal RF probe
Valve diode RF probe

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Name.....

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LIGHT AMPLIFIERS FOR X-RAYS

NEW TECHNIQUE MAKES VALUABLE CONTRIBUTION TO MEDICINE

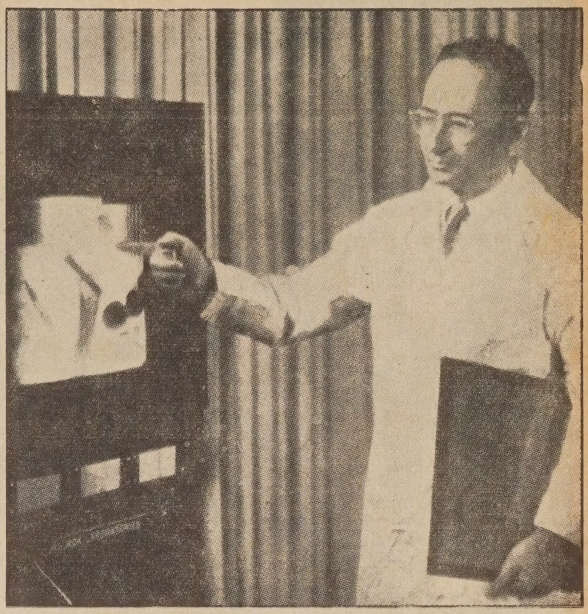
A little over two years ago, the R.C.A. laboratories announced that they had achieved considerable success in developing a light amplifier which was able to produce greatly amplified light images by simple means. This article describes some futher developments of the idea, with particular reference to its use in X-ray work.

A NEW family of electronic devices that appears destined to ease the task of the doctor, the radiologist and the radar viewer is taking shape at the R.C.A. laboratories, Princeton, New Jersey.

The principal identifying features of these devices are a thin panel type of construction plus an ability to receive dim or invisible radiation on the one side and convert it to bright, electronic light on the other.

Three new members of the family have made their debut in experimental forms:

- A thin screen amplifier for X-ray viewing, capable of multiplying by 100 times the brightness of X-ray images in certain types of medical examination, and at the same time reducing exposure of the subject to X-rays.
- Two types of storage panels that can brighten and hold for prolonged viewing projected radar and other light images to which they are exposed only for small fractions of a second.



The amplifying screen is capable of increasing by 100 times the brightness of X-ray images.

LIGHT "SANDWICH"

The light amplifier and the panel devices that have subsequently been developed employ arrangements of two special materials in adjoining layers sandwiched between transparent electrodes to form a thin screen.

One of these materials is a photoconductive powder which conducts current only when it is exposed to X-ray radiation or to visible or invisible light. The other material is an electroluminescent phosphor, also in powder form, which emits a bright light when an electric current is passed through it.

In operating the panel devices, a voltage is applied across the sandwich structure. In the absence of X-ray or light radiation the photoconductor acts as an insulator, blocking the passage of current.

When an X-ray or dim light image falls on the photoconductor, however, the material acts as an electrical "valve," allowing the current to pass through to the electroluminiscent phosphor in a pattern corresponding to the pattern of the X-ray or light radiation. The result is the reproduction of the image in the bright light emitted by the electroluminescent material.

The first of the new experimental devices to make its public appearance was the thin-screen amplifier for X-ray viewing, demonstrated by Benjamin Kazan, before a meeting of the American Roentgen Ray Society in Washington, D.C., where it was voted the best exhibit among the new developments displayed. Mr Kazan, who developed the device with the assistance of James E. Berkeyheiser and John Bernath, emphasised several novel features of particular interest to the radiologists:

1. It provides a stationary display of an X-ray image not only some 100 times brighter but with greater visual contrast than those produced on conventional X-ray viewing screens, permitting immediate viewing in lighted surroundings.

2. The device holds its bright image for extended viewing up to 30 seconds after a short exposure to X-rays, making possible a substantial reduction in the amount of X-ray exposure in direct viewing of camera recording of stationary images.

ELECTRONICS ERASE

3. A new electronic "erasing" technique permits the viewing screen to be cleared at any moment in a fraction of a second and reused immediately for viewing a new image.

While the screen cannot yet be used for continuous viewing of motion with low-level X-rays, according to Mr Kazan, the achievement of this end is the long-range objective of a continuing research program.

Such a panel might be used by a surgeon to obtain visual reports of progress during certain types of operation. One such case is the pinning of a hip, in which the location of the pin must be carefully determined by observation. Such checking during the operation is now usually accomplished by recording the X-ray image on film, hurriedly developing the film outside, rushing the result back into the operating room.

With a thin, large-area panel device, a bright X-ray image could be produced on the spot after only a short exposure to X-rays, and retained up to half a minute.

STORING IMAGES

Two additional experimental members of the electronic panel family were introduced at the most recent Electron Devices Meetings in Washington. Both were thin-screen devices capable of amplifying and "storing" images for prolonged viewing in radar and other applications.

One of these, developed by Dr F. H. Nicoll, involves the application of a new electronic principle to achieve an amplifier which, after a 1/100-second exposure to a dim image, stores and displays the image in bright form for several minutes or longer. The other type, developed by E. E. Loebner, H. O. Hook, and D. C. Darling, under a Signal Corps contract, is a high-resolution device combining picture detail with long image persistence.

Dr Nicoll described the new electronic principle in the first storage panel as the

(Continued on Page 119)

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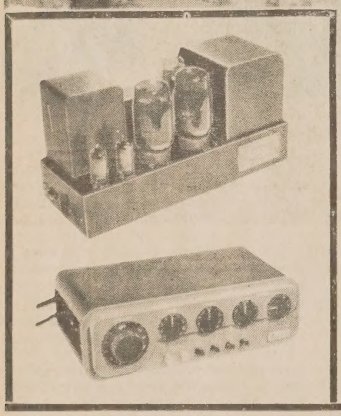

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In the illustration above you see the Quad II control unit and FM tuner on the left with Pick-up and Connoisseur Transcription motor fitted into a chairside cabinet. The Speaker system is the Goodmans 325 cabinet which carries the Trebax, Midax and Audium 80 speakers, cross-overs and attenuators.

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ELECTRICAL POWER FROM THE SUN

WORKS RADIOS SIGNAL SYSTEMS & HEARING AIDS

The almost inexhaustible power sources that lie in the sun far outstrip any others controlled by man but very little has so far been done to use them. Recent developments have produced new methods of direct conversion of sunlight to electric power. Several manufacturers have now come up with practical low powered devices.

This modular unit containing 144 silicon solar cells will supply 5 watts of power to a 6-volt battery system for an indefinite period without replacement or maintenance.

THE silicon solar cells now available from International Rectifier Corporation in America are practical photovoltaic devices capable of converting radiant or solar energy into electrical power of useful proportions.

When the magnitude of the energy showered upon the earth by the sun each second is considered, it is not surprising that the harnessing of this vast resource has been a constant challenge to man through the centuries.

Although several methods of utilising solar energy have been in use for many years, with varying degrees of success, the method considered most practical today involves the direct conversion of solar radiation into electrical energy by thermo-electric or photo-electric effects.

During the past few years this science has attracted widespread interest, particularly in the branch of science dealing with photovoltaic phenomena.

About 1876 the first barrier layer photo-voltaic cell was developed, utilising selenium. Through the development of collateral electrical and electronic technology, the selenium photoelectric cell gained wide application.

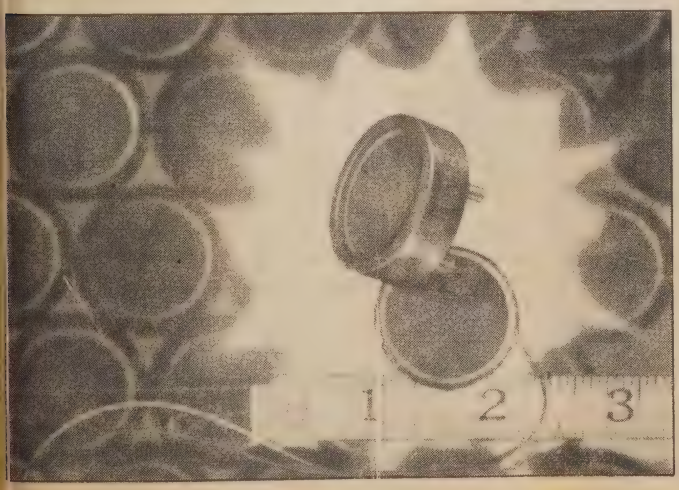
Recent research in the semi-conductor field contributed much basic knowledge which, when applied to the photovoltaic principle, resulted in silicon photocells with efficiency factors far greater than those of selenium forerunner.

The International silicon solar cell is of the p-n junction type. This p-n junction is formed on the surface of the silicon wafer to be exposed to illumination. The junction is composed of two types of semiconductors—the n-type and the p-type. The n-type material is obtained by adding certain impurities to the melt at crystal growing stage. The p-n junction is formed when impurities of another type are diffused into the n-type silicon wafer.

A cross-section of a silicon solar cell would show the p-type and n-type silicon to be separated by an extremely thin barrier layer which becomes a built-in, permanent electric field.

The movement and displacement of electrons and holes that occurs when light is absorbed by a silicon crystal and the subsequent phenomena that take place at the p-n junction cause a voltage difference between the silicon layers of

(Continued on page 15)



Silicon solar cells made by International are grouped together into units to increase power output.

3 separate functions

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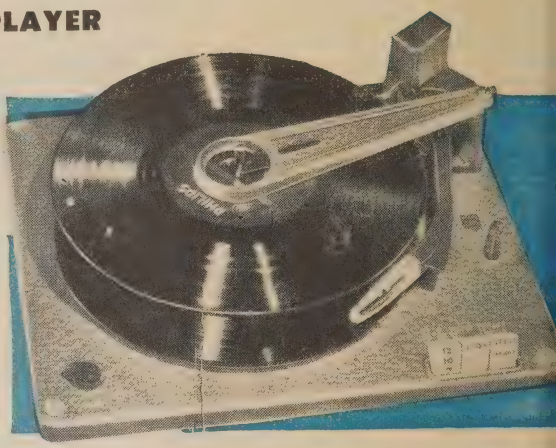

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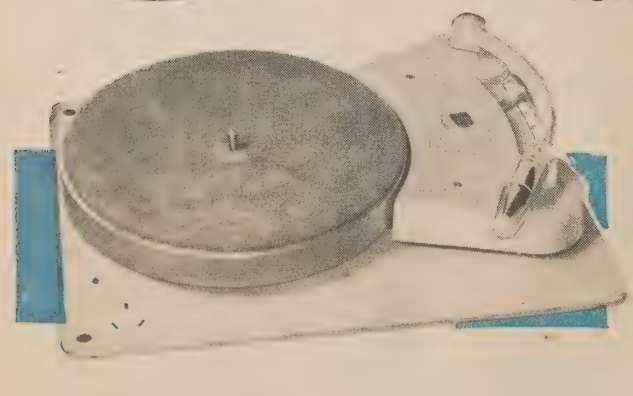

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FORWARD SCATTER IN ACTION

OPENS NEW FIELDS FOR MICROWAVE TRANSMISSION

The history of radio transmission is spiced every few years by some new technique of propagating radio waves from one point to another. Each such advance extends the utility and capability of radio to new applications, and broadens the technological frontiers. A relatively new technique for radio transmission is called "tropospheric forward scatter." The troposphere is the name given the airspace surrounding the earth, and reaches a height of 40-50,000 feet.

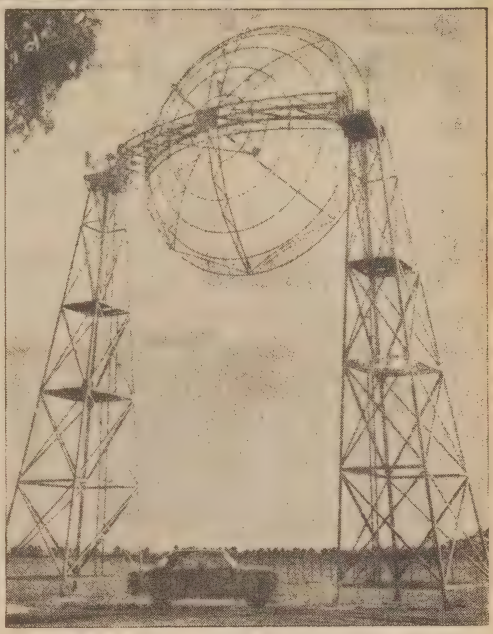
SCATTER Propagation permits reliable communication over hundreds of miles at frequencies (wavelengths) that were formerly limited to essentially line-of-sight distances. Tropospheric scatter propagation is particularly adaptable to frequencies above about 100 megacycles per second, and includes the so-called "microwave" frequencies. Its importance is evident when it is realised that station separations of 100 to 300 miles can be used instead of the more usual 25 to 35 miles typical of the familiar radio-optical transmission techniques.

In remote, uninhabited, and often inaccesible areas of the world, high capacity communication systems can now be built that formerly would have been impracticable. It is for this reason that tropospheric scatter systems were first applied in the Arctic regions of North America.

INTERNATIONAL CHANNELS

World-wide radio transmission is as old as radio itself, but such transmissions were basically of small communication capacity—one telephone or one broadcast program, or a few telegraph channels for each system. On special international circuits, certain techniques permitted four simultaneous telephone conversations. The new long-distance tropospheric scatter method allows dozens of telephone channels and even television to be transmitted.

The principle of scatter reduced to simplest terms is that, if enough power is concentrated in the correct direction, small amounts of it will be transmitted over long distances



The 30ft metal saucer used at Woomera for forward scatter transmission.

by the "scatter" dispersion of power through the atmosphere.

It might be likened to the distant glow of a brightly lighted city which can be seen long after the direct light rays have disappeared or are blocked by some object or at the horizon.

The glow is the result of "scattered" light, quite low in amplitude, but detectable over much longer distances than if powerful searchlights had been used and aimed towards detecting points fitted with reflectors to gather the light.

Using radio waves instead of light, the same general principles apply, and by special aerial design, some of which are illustrated here, very powerful radio beams can be used.

The huge waste in power unavoidable with this system may be made up for by the fact that, without it, communication of similar performance would not be possible.

HOW SCATTER WORKS

The scattering effect takes place in the atmosphere due to localised turbulence and variations in moisture distribution. There is some wave scattering from these atmospheric variations, but the effects are small. Nevertheless, if adequate power is transmitted in narrow beams, these scattered waves are detectable at locations far beyond the horizon and can be received with large antennas and abnormally sensitive receivers.

The principles of scatter propagation have been known for several years, but the equipment necessary to produce sufficient power economically for transmission at these frequencies has only recently been developed. Power sources, as well as receivers, depended on the evolution of suitable valves, and it is difficult to generate very high power on microwaves.

Many countries are experimenting with scatter, and some permanent plans are being put into practice. On page 3 is shown the large antennas with dual horn and wave guides, being erected in Norway as the first leg of a long scatter communication chain running across Europe.

(Continued on page 15)

The Marconi aerial in Devon used for experiments in England.

At last!

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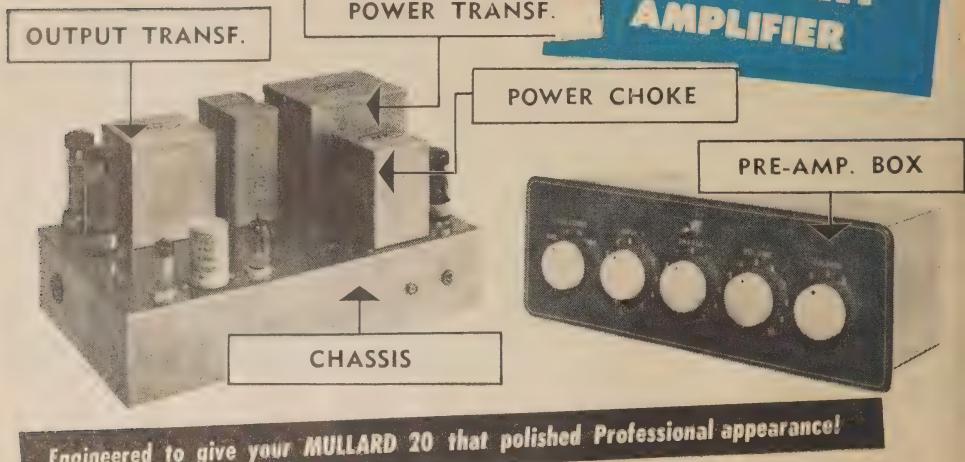

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OLAR CELLS BRING OWER FROM UNLIGHT

(Continued from Page 11)

e cell, thus causing an electric current flow.

It could be said that silicon solar cells e newly found "keys" to the advanced ilisation we seek, which must be aced in the right "locks" before their ll effect can be realised.

There are today many practical appli-tions for silicon solar cells, particular-in the nations which have not realised ll industrialisation.

It has been stated by Dr Ba Hli, Sc.D. nion of Burma Atomic Energy Centre, at every second of a sunny day, Burma ceives 240-million kilowatts of solar ergy, as compared to the 100,000 kilo-atts generated in all of the electrical nerating stations they have. The swer to their needs as well as those of vanced science may well be found in e application of solar cells.

International Rectifier Corporation has der development several solar power nverters conceived to provide a ready urce of power to specific applications.

ANY USES

Silicon solar cells now have a dozen mmercial and consumer applications, cording to the semi-conductor division Hoffman Electronics Corp.

Hoffman is using them to power a ansistor portable radio. They provide constant charge for nickel-cadmium tteries in Zenith eyeglass hearing aids. th Thomas has a solar-powered clock.

Other uses reported are movie camera erture control, robot weather stations, dio transmitters, microwave relay sta-ns, punched card and tape computer adouts, control devices, flasher beacons d flashlights.

The cells power the Vanguard satel-e transmitter. In the Aero-bee-Hi cket, they activate a motion picture mera so that it takes pictures in the inning rockets only when facing earth.

The U.S. Forestry Service has used a icon solar converter to power a low-wer transistorised transceiver located a mountain-top lookout post. Mes-ges were relayed as tone signals.

OLAR CONVERTER

The solar converter consisted of ap-oximately 500 square inches of silicon ar cell area. It was mounted on the bkout tower and kept a standard, 12-lt automotive battery continuously harged while operating a radio relay tion.

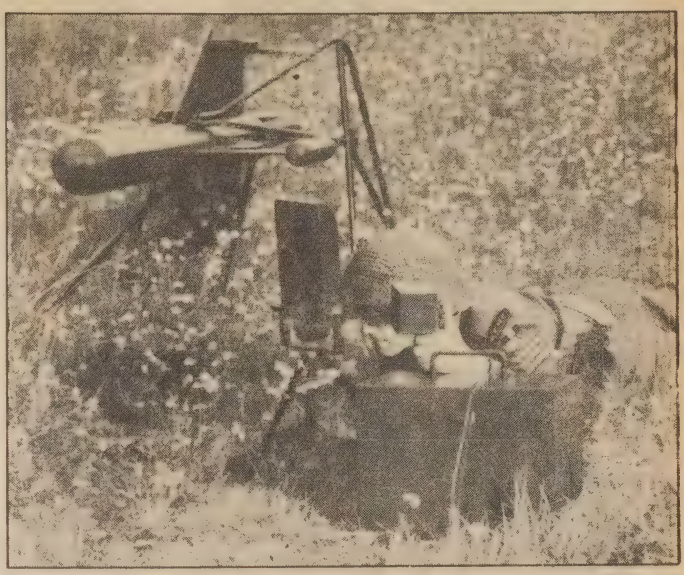
The basic component of the new Hoff-an commercial solar system is a "odular unit," a 12 by 20 inch alumin-m panel containing 144 wafer-thin, cir-lar silicon solar cells which instan-aneously convert sunlight directly into ectrical energy. This energy is either d into storage batteries or used rectly.

Each unit takes 10 per cent of the n's light energy to turn out five watts electrical power. The units may be connected together to produce multiples of five watts, either as a direct power supply, or for charging continuously over an indefinite time, six, 12 or 24-volt storage batteries.

Hoffman says the cells will respond at a rate of 50,000 impulses a second, permitting their use in high-speed air and ground computers. They may also be used as infra-red sensors and fire or flame detectors.

Silicon solar cells have an efficiency of about 10 per cent, sufficient to convert sunlight into electricity at the rate of 100 w per square yard of converter area. They will also convert incandescent light. Estimated lifetime of the cells is 10,000 years.

POCKET-SIZE GUIDED MISSILE



British and West European Governments have shown great interest in this "pocket size" guided missile for foot soldiers. Developed as a private venture by the Pye group of companies, it has an unusual guidance system for use against tanks and other moving targets. It is 5ft long and can be carried by one man. It has boost and sustainer rockets using solid fuel and is directed to target by signals from a joystick control near the launching site. It was displayed for the first time at the Farnborough Air Show this year.

FORWARD SCATTER TECHNIQUE IN ACTION

(Continued from page 13)

In England there are several examples of the system. The one illustrated is a Marconiphone link between Start Point, Devon, and Galleywood, Essex, a distance of more than 200 miles, using a frequency of 848 Mc, and an initial capacity of 24 telephone channels.

It is designed for a maximum of 68 simultaneous channels, but features are provided which will subsequently permit experimental wide-band transmission with a view to carrying much greater numbers. Later on TV programs will be sent over the link. The Start Point transmitter uses a water-cooled four-cavity Klystron developing an output power of 10 Kw. The associated aerial system, a 30ft paraboloid dish excited by a horn radiator, is mounted with its centre 35ft above ground. This aerial system has a gain of 36db over a dipole and gives an ERP of 40 megawatts.

Receiving equipment at Galleywood is dual diversity with two dish aerials of 30ft diameter spaced 100ft apart.

This method has been found to counteract rapid fading which is characteristic of tropospheric scatter.

In Australia a scatter channel is being tested between Woomera and Salisbury, South Australia, by the Weapons Research Establishment, Electronics Section. To date results suggest a possible range of 500 miles for the system. It may yet be posible to use it as a microwave link between capital cities for TV programs and multiple channel telephony. So far experiments have been made with voice transmissions.

They have raided the pantry—a refrigerator in the modern kitchen, stocked with food in cartons, plastic bags, tins, bottles and sealed pockets. Preserving methods allow us to stock up months ahead with a wide variety of foods.

Science Helps Keep Our Food

Our civilization would come to a standstill if we had to eat our food while it was fresh. The art of preserving it is therefore a vital one, and supports a huge industry with a world-wide coverage. Without it, thousands would starve.

ONE of the factors which makes life so complicated is the necessity to eat.

In very early times man was not as fastidious about his food as he is today. His needs were met by a lump of raw meat from an animal he had hunted, and the raw fruit from trees in the natural forests or the grass growing at his feet.

The source of the meat he consumed wasn't much of a worry either for it often consisted of steaks cut from a choice part of the anatomy of his fellow man.

SIMPLE LIFE

Early man didn't worry in the least about consommies, mornays, sautes or sauerkraut and so on. Thus his life was much simpler and mainly devoted to eating and fighting. There was no question of what Mum would cook him for dinner. She didn't have to cook anything. All she did was to help in the hunt, draw the water and look after children.

It would seem that it was the French man who started to make things a bit complicated. At least that is the impression I gain from a perusal of the menu in any posh nightclub or hotel.

Not only did he invent the most complicated concoctions but he gave the most outrageous names to the simplest of foods.

This allowed him to charge outrageous prices. The names he invented were so attractive as to completely conceal the fact that the ingredients used were merely "sausages and mash."

As the population of the earth increased, food became scarce at times, and man was forced to find means of preserving what food he could get for future use.

by Calvin Walters

No doubt there were times when m and his family were forced to eat fo which was rather "high." He may ha come to like some of it and this tenden exists even to the present day evidenced by the avidity with whi some people consume the variety smelly cheeses and ancient game. their wives served up a steak in st condition they would go for a divorce

Nature's process is an endless cyc She is always breaking up the compl organic food substances into simpler st stances so that other forms of life m be maintained.

ENZYMES

While an animal, plant or any oth living thing remains alive, there circula within it substances which inhibit dec

There are many valuable elements the living body and unless these eleme are returned quickly into natural after it has died, there will be consta loss of both energy and matter going all the time.

In order that this will not happ nature has provided means whereby th elements can be put back into the cy without undue delay.

Certain chemicals called enzy begin to act on the dead tissue, and aided by bacteria and moulds in the p cess of breaking down animal or ve table matter.

It has been proved that in some ca the early stages of decomposition prove the palatability and nutri qualities of some foods, but the deg to which decomposition can be allo to take place is limited within a narrow range.

ENVIRONMENT

The preservation of food is theref achieved by controlling the environm which enables living organisms such bacteria and moulds to live. Thus chemical reactions which are aided these organisms are prevented or layed.

Now bacteria and moulds, like other forms of life must have fo warmth and moisture and oxygen order to live. They are also sens to the degree of acidity.

It seems self-evident, therefore, tha means are devised to adjust temp ture moisture, air and acidity to c

hin the range which is unfavourable the growth of bacteria and moulds, n preservation of the food will be ected.

The scientific explanation of the prin-les involved in food preservation was always understood, notwithstanding t certain methods have been known centuries.

Probably the oldest method known is t of drying, or, to use the modern minology, dehydration.

The effectiveness of drying was, no ubt, observed in quite early days by ne native who had found a piece of nth-old meat which had inadvertent-been left in the sun.

Today the sun-drying of fruits is a ge scale commercial undertaking in ny parts of the world. Most of the ied fruits on the market are sun-ed.

EHYDRATION

There is very little dried meat sold mmercially, but some trading is done North America with "pemmican"—ed ox or buffalo flesh prepared by dian tribes.

During the last war dehydration was orted to on a large scale mainly for e purpose of saving shipping space.

Dehydrated vegetables in particular e not a popular line mainly because ey do not actually return to their iginal state when being restored by aking in water.

There are several reasons for this. The o main ones are, firstly, that, in order prevent drying out of the outer por-n of the vegetable before the inside as trapping moisture inside the vege-ble), it must be cut into very small eces so that it can quickly be dried thin the temperature range. The dried getable is, therefore, not attractive in pearance.

The second reason is that the shrink-e which takes place alters the tissue ructure of the vegetable so much that when restored by soaking in water, the flavour and texture alteration is quite manifest to the taste.

Perhaps the most popular of the dried foods is dried milk. This is a very convenient substance and modern methods have enabled the valuable butter fat and protein content to remain practically unaltered.

Milk is dried artificially in one process by feeding it between two drums, which are only .05 inches apart. Steam under pressure of from 40 to 100 pounds per square inch is fed into the drums which rotate at a speed of about 15 revolutions per minute. The temperature of the drums is about 185 degrees Fahrenheit.

The milk is, therefore, air-dried. Another process which is very popular makes use of atomisation.

The milk is first concentrated and then fed on to a turbine-driven disc which atomises it into a fine spray. This spray is thrown into a blast of hot air where the milk dries almost immediately and falls to the floor of the drying chamber.

The atomising process has several advantages over the drum process. While the high temperature of the drums coagulates the albumin and the globulin, the spraying process does not. The lactose is unaltered, and taken all in all the quality of the product is much higher.

Dried milk is a highly digestible product and ranks well as a food.

DRIED MILK

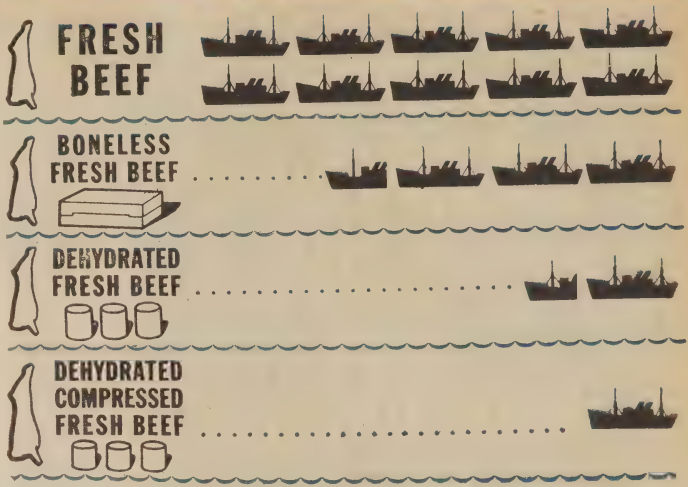
That very popular food known as malted milk is prepared by taking about 40 per cent of whole milk and adding this to about 60 per cent of malt extract specially prepared from a mash of barley malt and wheat flour. The malted milk is first concentrated and then subjected to drying at a temperature under 140 degrees F.

The effects of drying foods is varied. As a result of loss of moisture, proteins, fats and carbohydrates are concentrated. Some foods have their vitamin content impaired. Usually all the vitamin C content is lost, while sun-dried fruits lose vitamin A.

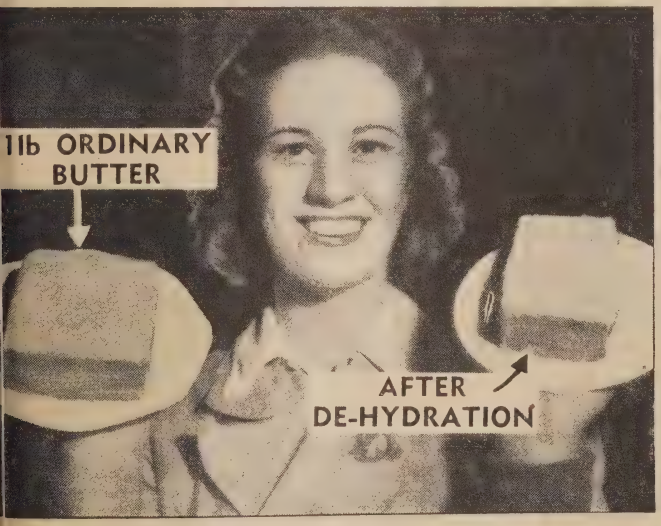
A new process lessens the loss of vitamins by packing the product under vacuum in moisture-proof air-tight containers into which an inert gas has been introduced.

All drying processes rely on the de-

MODERN METHODS SAVE SPACE



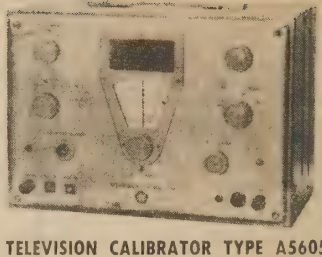
This diagram illustrates how modern methods of heating and preserving food can save shipping space. Progressive research has reduced it by 90 per cent in this instance.



Dehydration can even be applied to butter, as this picture shows, with a marked reduction in required volume.

AWA

TEST EQUIPMENT for EFFICIENT TV SERVICING

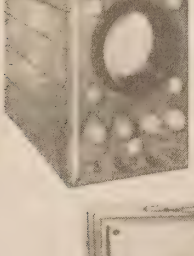


TELEVISION CALIBRATOR TYPE A56057

Frequency range: 19 to 260 Mc.
Crystal frequency: 2.5 and 5.5 Mc
RF Output: More than 100 mV.
Provision for vertical and horizontal bars.

UNIVERSAL BRIDGE TYPE A56048

Resistance range: 0 to 10 MΩ.
Capacitance range: 10 μμF to 10 μF.
Comparative meas: .1 to 10.
Percentage measurements: −20% to + 25%.
Provision for measuring inductors with comparison to external standards.

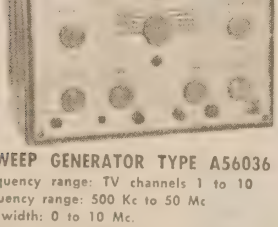


OSCILLOGRAPH TYPE A56031

Frequency range DC to 1 Mc
Time-base: 3 cycles to 30 Kc
Sensitivity: 10 mV RMS/inch

VOLTOHMYST TYPE A56010

DC. volts: 0 to 1500 V.
AC. volts: 0 to 1500V.
Resistance: 0 to 1000MΩ
DC. current: 0 to 1500 mA.
Accessories available for . . . 30 kV and 250 Mc



SWEEP GENERATOR TYPE A56036

RF frequency range: TV channels 1 to 10
IF frequency range: 500 Kc to 50 Mc
Sweep width: 0 to 10 Mc.
Provision for Oscillograph time-base and phasing control.

FOR FURTHER PARTICULARS CONTACT :

Test & Measuring Instrument Dept.

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rivation of moisture to destructive bacria and moulds. When moisture is reitroduced into the product, then bacteria nd moulds can once more take hold nd multiply. Thus dehydrated foods ust be used without delay after being egenerated in water.

The outstanding method of food reservation is that of refrigeration. Here ontrol is exercised by the reduction of he temperature to below that which is ecessary for bacteria to flourish. Tissue uids are also rendered unavailable to acteria by freezing.

Decomposition of food is not actually revented by refrigeration. It is merely ostponed so that when refrigeration is emoved decomposition can take place in he normal manner.

Refrigeration can be divided into three road classes namely chilling, freezing nd deep or snap freezing.

CHILLING

In chilling, which is the method comonly adopted where meat is to be kept o longer than about 40 days, the food subjected to a temperature of about 9 degrees. The heat is extracted slowly nd freezing is avoided.

Even at this low temperature the ffects of decomposition will begin to ppear after about 40 days. An extension f the period of up to 14 days may be ccomplished by adding carbon dioxide o the atmosphere.

The storage of other foods such as egetables, eggs and fruit is rarely carred out at temperatures below 32 degrees F.

The reason lies in the fact that, owing o the large surface areas relative to the olume of the product, heat extraction roceeds rapidly, and freezing takes lace. This is a desirable result for hese reasons:

Where meat is to be kept for a period f more than 40 days, it is generally rozen at a temperature of about 10 egrees F.

While this method retards decomposion indefinitely, it brings about certain hanges in the structure of the tissue The freezing point of meat is 28.4 degrees F. From this temperature down o 25 degrees ice crystals form in the issues, the size of the crystals being in roportion to the length of time taken o reach the lower temperature.

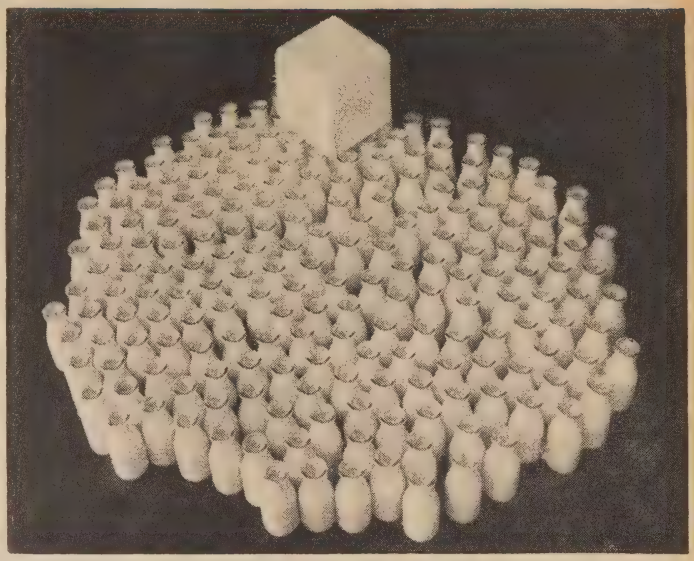
ICE CRYSTALS

Generally speaking the smaller the carass the less chance there is of large ce crystals forming because heat loss s rapid and faster freezing is achieved In large beef carcasses, however, hea oss is slow and large ice crystals are pt to form. This results first in rupture of the cells due to the expansion of he ice and secondly to the concentraions of proteins such as albumin and lobulin because the body fluids which ontain these substances freeze.

This concentration of proteins renders hem insoluble. The result of all this is hat, when the frozen meat is defrosted. he ruptured cells allow the escape of utritious tissue fluid, which is evidenced by the undue amount of drip which akes place.

The valuable concentrated proteins which have been rendered insoluble do ot dissolve back into the remaining issue fluids, and while the meat may e tender, due to the ruptured tissue

POWDERED MILK—STORY IN WORDS



A dramatic illustration showing how a 33lb block of pressurised milk powder represents the food material from 26 gallons (208 pints) of milk.

cells, the flavour and food value is not preserved because of the loss of albumin and globulin.

The freezing of vegetables is even more drastic, and brings about almost complete destruction of the cellular structure. Almost anyone will have noticed that vegetables, such as lettuce, which have been frozen, become nothing more than a soggy mass when defrosted That is why these products are kept in a separate compartment in the home refrigerator where there is no risk of freezing.

Eggs are rendered almost unsavoury both in taste and appearance by freezing. Tissue damage is very great in this case, and a defrosted frozen egg is a pasty, nasty-looking mess.

In order to overcome the defects of slow freezing, considerable research was directed to methods which would bring about reduction of temperature at a fast rate in order to avoid the formation of large ice crystals and subsequent rupture of the tissue cells

There are several methods by which this has been achieved but none of them as yet has been successful in processing any but small units of food, such as poultry, fish, cuts of meat, small vegetables and the like

The principle involved is to use extremely low temperatures applied to the product in such a way that freezing is rapid. Ice crystals form but these are so small as to have no effect on the tissue cells.

The quick-freeze plant must have ancillary units for special processing before treatment, and are, therefore, costly.

The ancillary plants are used, for example, to blanch certain vegetables before freezing, to glaze fish with ice to prevent oxidation, to treat meat with glycerine to prevent dehydration or to render soft fruit stable by treatment with syrup.

The two mostly used processes of quick freezing are the plate process (also known as the Birds Eye process) and the wind-tunnel process.

QUICK FREEZING

The plate process makes use of two plates between which the food is pressed Refrigerant at a temperature of down to minus 22 degrees F. is passed through the plates. Thus the food is quickly frozen.

In the wind-tunnel process the food is wrapped and passed into a tunnel or chamber through which air at extremely low temperatures and at a high velocity is drawn.

The modern deep-freeze cabinet makes use of a combination of these two processes by using vertically spaced shelves through which the refrigerant passes through coils. Air is blown over the plates at the same time.

Once any quick-frozen food has been allowed to rise to a temperature of 25 degrees it cannot be again subjected to quick freezing without tissue damage as in ordinary freezing. It must therefore be used immediately.

Today almost any food is offered for sale from quick-freeze cabinets placed in stores.

There are many other methods of preserving food among which are sterilisation and canning. The latter incorporates sterilisation which must take place during the canning process.

Chemical preservation includes the addition of sugar which inhibits the

(Continued on page 119)

Telecomponents Pty. Ltd.

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Type TV220—a power transformer for TV incorporating a 5 volt rectifier filament winding and giving an output of 275 volts D-C at 300 m.A.

Type TV 221—a 300 mA choke for use with the TV 220 transformer.

Type TV 214—a vertical output transformer, ratio 15:1, suitable for output tubes on "B" boost e.g. 6CM7 and 12BH7 matched amongst others to the M.S.P. yokes.

Type TV 231—a vertical output transformer, ratio : , suitable for a 6BM8 output tube and a Philips yoke. In addition a complete range of the following is available:

★ **Vertical blocking oscillator transformers.**

★ **Horizontal blocking oscillator coils.**

★ **Line wave coils.**

★ **70 deg., 90 deg., 110 deg., flyback transformers.**

★ **Bifilars with and without cans suitable for staggered tuning.**

★ **Sound and limiter I.F. transformers.**

★ **Ratio detectors.**

★ **Peaking coils and traps.**

★ **Car radio vibrator transformers.**

★ **Coils and transformers for Broadcast and S.W., including Flying Doctor etc. (standard and miniature)**

★ **Power transformers.**

★ **Chokes.**

★ **Audio transformers (standard and Hi Fi!)**

Should any items you require not be listed quotations can be supplied promptly without obligation. In addition, our laboratory engineers are readily available to assist with design on application problems — another Telecomponents service.

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Technical Review

A NEW DESIGN FOR STEREO LOUD SPEAKERS

tereo's coming of age has caused esigners to focus new attention on ne special factors applying to that ype of reproduction. Chief among nese factors, which are largely re ponsible for the "spread" and aturalness of stereo (but which, nterestingly, have been given little ttention in the past) are omnidirec- onality—not merely "fanning out" f the sound but true circular dis- ribution — and linearity of phase nift (constant time delay) in the coustic transmission system repre- sented by the speaker.

THIS speaker system takes into account not only the traditional demands of peaker systems, but also the special re- uirements of the new art of stereo. Linear phase shift maintains the tem- oral spacing of the elements of any ansmission — for example, the rela- onship of overtones in reproduced usic. Disturbance of the relationship, hile not easy to measure, does con- itute a serious intermodulation effect. To meet the requirements of linear nase shift, the ideal reproducer would e a zero-point source that would adiate a perfect wavefront over the ll audio spectrum. Such a reproducer ould also be inherently omnidirec- onal, something like a sphere of in- nitely small size expanding and con- acting. The same design techniques nat make for linear phase shift do, the same time, make for omnidirec- onality.

DIRECTIVITY

Omnidirectionality is a problem rgely restricted to mid-range and igh frequencies. These tones tend to eam, resulting in unpleasantness and ck of naturalness in reproduction, aused by the loss of the spatial char- cteristics typical of live sound.

Omnidirectionality is important, too, or its ability to re-establish in a small oom something of the natural ratio reflected to direct sound (often as igh as 4 to 1) that we hear in the oncert hall. Obviously, any reproducer nat can approach this ratio correctly ill sound more lifelike.

The HFS-2 has been developed to eet these demands as well as the other accepted criteria, such as extended and flat frequency response, low distortion and good transient recovery. It is effectively a four-way system. Bass from 200 cycles down is generated by the rear of an 8½-inch driver working into a slot-loaded conical horn (more on this later). The front of this driver's cone crosses over at 200 cycles, by virtue of its acoustic relationship with the

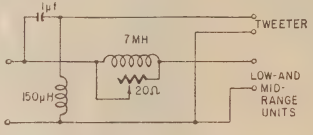


Fig. 1—Crossover network of the HFS-2. This can be used only with an inherently well damped system.

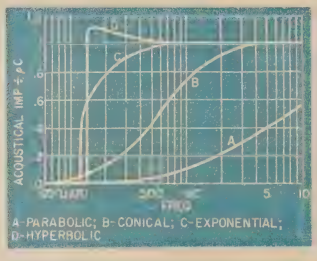


Fig. 2—Conical, hyperbolic, parabolic and exponential horns compared.

rest of the system, and continues to respond to about 2,000 cycles.

A mechanical crossover then feeds signals in the range from 2,000 to 8,000 cycles to a free-edge, specially loaded cone, the outer boatlike object just inside (above) the driver in the cutaway photo on the next page. The range above 8,000 cycles is electrically divided by a 12-db/octave network consisting of a 1-mfd capacitor and a 150-mh coil (Fig. 1), and fed to an independent driver (tweeter), whose design parameters resemble those of the upper mid-range unit.

This tweeter radiates from both sides of the free-edge steep-sided vertical cone or cornet mounted above the 8½-inch speaker. The outer surface of the cone produces a 360 degrees horizontal radiation pattern. Radiation from the inner surface provides the vertical component for a complete hemispheric dispersion pattern.

If this were a conventional vertical cone with an edge forming a right angle to the voice coil axis, it would have a relatively narrow-band response. What's more, the lateral radiation would all be in one plane while the vertical response would be beamed, not dispersed.

CONE DESIGN

In this design the edge of the cone is so cut as to provide a constantly varying distance between the cone's edge and the voice coil. This broad-bands the tweeter's response while smoothing it to avoid undesirable peaks. This shaping also spreads the radiation vertically so that it is not restricted to one plane horizontally.

To enhance this "umbrella" coverage further, a rigid and nonmoving "acoustical loading cone" or "plug" is inserted concentrically within the radiating cone.

This plug forms an air gap between itself and the inner surface of the radiating cone. This gap acts as a ring radiator. Because of the varying distance between its effective radiating surface and the voice coil, this ring radiator produces a desirable phase displacement between any two or more acoustical elements (air particles) in that gap.

As a result of this displacement, the radiation pattern from the tweeter takes on a hemispherical shape. An additional benefit from this plug is that it obviates any effects of response peaks or instability which might be caused by radiation from diametrically opposite

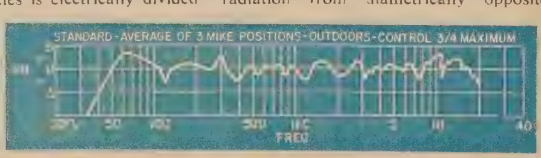
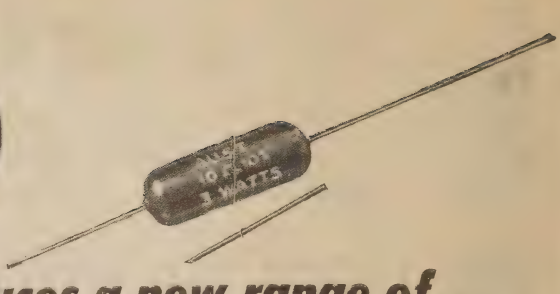
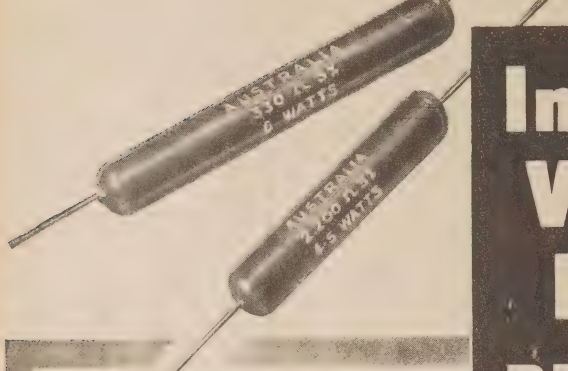


Fig 3 — Frequency response of the HFS-2 system.

I.R.C. AUSTRALIA



Introduces a new range of...



Insulated Vitreous Enamel RESISTORS

These resistors are the result of the I.R.C. Research Laboratory's efforts to provide "something better" in vitreous resistors.

Their special features are well worth investigating:

(a) Fully insulated—no exposed parts to short.

(b) Specially shaped ceramic body enables silver solder terminations to be made below the winding level, thus protecting the joints from the possibility of mechanical injury.

(c) Terminating method results in a more even coating, free from pinholes or high spots which could chip and permit the ingress of moisture at vulnerable points.

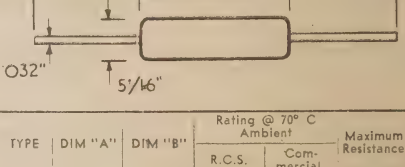
(d) Truly axial leads and general design provide for the maximum moisture seal by increasing the path between the point of entry of the pigtail into the coating and the start of the winding.

DETAILS OF CONSTRUCTION

- Resistance wire wound upon ceramic former under strict tension control.
- Resistance wire silver soldered to tinned leads.
- Truly axial leads secured into the body by a special cement.
- Vitreous enamel **coated over entire body and terminations.**
- Coefficients of expansion of ceramic, wire and coating carefully controlled and balanced

- **ASK YOUR USUAL SUPPLIER FOR FULL DETAILS NOW.**

These resistors are now being made in Australia and conform to R.C.S. sizes and ratings, and are available from stock in all R.C.S. values. This new product is supplementary to the well-known range of I.R.C. resistors available in A, B and C coatings.



TYPE	DIM "A"	DIM "B"	Rating @ 70° C Ambient		Maximum Resistance
			R.C.S.	Commercial	
RWV 4J	3/32	4 1/8	3.0	4½ watts	4,200
RWV 4K	1 7/16	5 7/16	4.5	7½ watts	9,200
RWV 4L	2 3/32	6 1/8	6.0	10 watts	13,200

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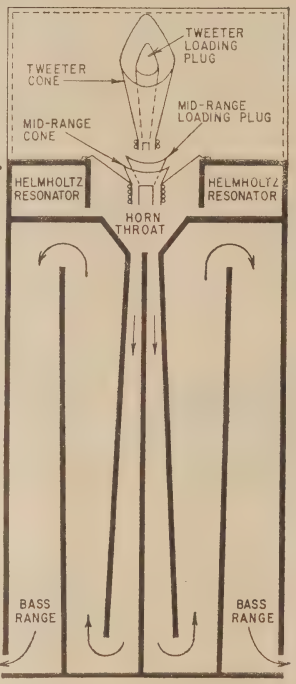
(50 yards from King St.)

Cutaway model of the Eico HFS-2.

Section showing details not revealed in the cutaway photo.



points on the inner surface of the radiating cone.

Finally, by mounting this configuration literally out in the open (see photograph), a practical omnidirectional sound source is created which represents a close approach to the theoretical ideal of a zero point source.

The design principles used in the tweeter can be varied to provide correct response over different portions of the frequency range, still retaining the same optimum distribution pattern. In the mid-range reproducer element of the HFS-2 (known in its prototype form as the Hegeman Standard) it was found that the frontal radiation from the cone used for the low-frequency driver provided excellent response from slightly below 200 to above 8,000 cycles. What was needed was to stabilise this response, eliminate any peaks, provide for the same hemispherical radiation pattern as in the tweeter, and furnish a means of balancing the mid-range response with the high and low ends.

SECOND CONE

Another free-edge cone of special shape with its non-moving acoustical loading cone, is used to stabilise and smooth the response, as well as to produce the desired hemispheric radiation. The power response of this units is such that it is inherently almost perfectly balanced with the high and low ends.

To adjust this balance a specially designed control — the 7-mh choke and 20 ohm potentiometer of Fig. 1—changes the relative amounts of high-and low-frequency energy fed to the woofer and mid-range driver. With the resistor nearly shorted, all frequencies flow equally into the speaker. With it set near its full 20 ohms, the lower frequencies are favoured. Its range provides sufficient variation to balance the system to suit most acoustic environments.

In all the literature of high-fidelity, no subject has been discussed and debated more than low-frequency reproduction.

In selecting a horn for the bass element of this system, considerable weight was given to two advantages: The horn can provide an even wider pattern of sound distribution, and it can couple acoustical energy efficiently to the listening environment from a relatively narrow source (the speaker cone). Horns have their problems, too, but these problems are subject to solution, as we shall see.

Possibly no reproducer conformation has been as much abused in the literature as the conical horn. That type, it has been fashionable to point out, has a rapid rolloff in response and is therefore unsuited for hi-fi applications. What has not been pointed out—but what is quite apparent from even a cursory study of published curves—is that the conical horn remains far and away the smoothest responding horn known—even when it is rolling off.

The response curves for different horn shapes are shown in Fig. 2. The conical horn begins to show its merits as a bass reproducer when one investigates carefully the behaviour of horns near cutoff frequencies, and the use of horn mouths that are—in theory at least—inadequate in diameter. It is certainly true that the efficiency of a conical horn does begin to roll off at a higher frequency than other horn shapes but that rolloff is very gradual, very linear. And it is equally true that the conical horn continues to respond — albeit at lower amplitudes — an octave below an exponential horn of equivalent size!

LESS COLOURATION

Further, if one accepts the general proposition that sharp changes in amplitude response represent large changes in phase characteristic, and that gradual changes indicate that the phase characteristic is more linear, it is obvious that the conical horn must produce less colouration of whatever signals it is reproducing than can either a hyperbolic or an exponential horn. To put it another way: the smoother roll-off in efficiency of the conical horn represents a lesser change from the desired linear phase characteristic (so essential to natural reproduction) than is possible with an exponential horn.

There still remains, of course, the problem of horn mouth size for adequate bass response, and the efficiency at the very low end. Any horn has a natural cutoff point, determined by its length, mouth diameter and rate of flare. A horn would require a mouth diameter of 7ft to reproduce 50 cycles. This is obviously out of the question for practical applications. "Folding" the horn to make it physically shorter and using the corner of the room to lengthen it acoustically help. But there is a better solution.

Just as in transmission practice it is entirely feasible to replace, for example, a required section of telephone line with a properly devised termination, so acoustically it is possible to replace a section of a horn with a properly devised acoustic termination. At low frequencies, such a termination is represented by a narrow slot. Consequently, by replacing the mouth of a relatively short conical horn with a critically dimensioned slot, it is possible to cause the driver mounted at the horn throat to behave as if it were working into a horn of virtually infinite length.

EFFECT OF SLOT

The slot confines enough air within the horn to build up a suitable resistance for the driver (at the horn throat) to work against. At any point from the slot back to the driver, the air in the now shortened horn presents the same impedance to the driver as if the horn had continued to an optimum length and mouth diameter for frequencies below 30 cycles. Additionally, the acoustic impedance now inside the confined horn produces a greater air pressure within that horn than in the room outside the horn.

As a result of this internal pressure, the slot functions acoustically as if it were many times its own area. Behind it, every movement of the speaker cone sets up relatively high compressions of small masses of moving air. These com-

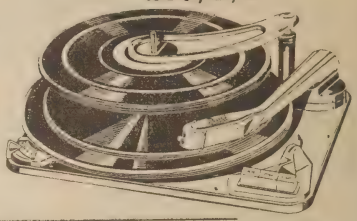
Dual

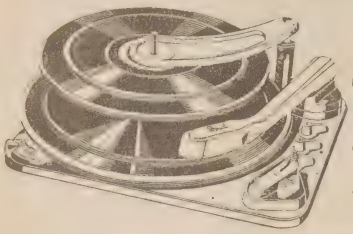
STEREO

New Release: 1004-S STEREO CHANGER

£37/9/6

In line with modern recording techniques we are proud to announce the release of the latest DUAL development Model 1004 S Stereo-Changer. All the necessary technical requirements have been incorporated for the efficient reproduction of Stereophonic Records Three push buttons provide full control of all mechanical functions and the "Stereo-Key" permits the operator to switch from "Stereo" to Binaural reproduction of conventional records. Fitted with KS 2 Stereo head and twin sapphire assembly DN 3



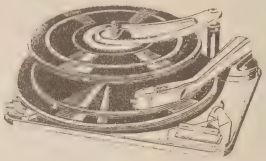


1005 — CHANGER £37/9/6

Fully Automatic with many superb features to guarantee faithful reproduction and reliability of operation. Automatic needle selection —built-in scratch filter—pause switch to control changing time cycle —roller glide selection of record size—Tonearm lock and many other carefully designed functions.

Fitted with the outstanding CDS3 cartridge and DN2 twin sapphire needle assembly.

All models can be supplied fitted in leatherette carrying case.

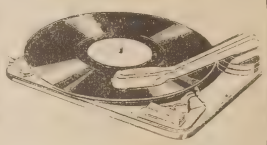


1004—CHANGER £32/8/6

A simplified version of the above model without automatic needle selection, scratch filter or pause control. Operation is by three push button control incorporating start, stop and repeat functions.

1004 – T12 AUTO-PLAYER £28/10

A new addition to the DUAL range this model is the result of numerous demands for an automatic player retaining all the gentle operations and safety features of the changers without the actual dropping of records. All possibility of damage to records and styli is eliminated.

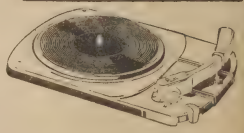


SPECIAL STYLI

DN24 (Diamond L.P. Sapphire Std.) £11/-/-
DN22 (Twin Micro Sapphires) £1/16/9
DN21 (Twin Std. Sapphires) £1/16/9

295 PLAYER £18/10/-

Fitted with automatic cut-off this model is particularly suitable for building-in where space is limited or for use in portable units. Fitted with the CDS2B cartridge and DN2 Needle assembly the same high quality of the larger DUAL models is retained



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ssions provide the same acoustic ergy as would otherwise be provided large masses of air under less com ession. The higher pressure within horn—higher with respect to the nor- l pressure of the atmosphere in a m—results in a high particle velocity the slot, causing the acoustic energy the horn to be transmitted to the ening room with the effect and impact a jet stream. The comparison, by the y, is no mere analogy—as anyone o has held a lit match near the slot ring a heavy bass passage can testify!

This high-pressure technique permits ting the lowest bass tones from what ght normally be considered a "small" is driver—an 8½in cone.

FICIENCY

Slot dimensions are chosen to provide imum radiation resistance (highest iciency) at the very low frequency end, t below 30 cycles. These dimensions, tunately, also provide radiation re- ance below optimum for the upper is frequencies, reducing their efficiency match that of the very low end. In s way, the entire bass line becomes entially flat.

In practice, loading extends to 20 cles, producing a response that is ooth, full and clean—with no possi- ity of doubling. The net result, in ect, is a conical horn with no bass l-off! And because its overall effi- ncy is comparable to that obtained m the radiators used for mid-range d highs, the entire system has a uni- m efficiency throughout its range, as y be seen in Fig. 3.

What's more, the shortened horn gth actually improves transit-time racteristics, so that the phase relation- ps of all bass tones are largely pre- ved.

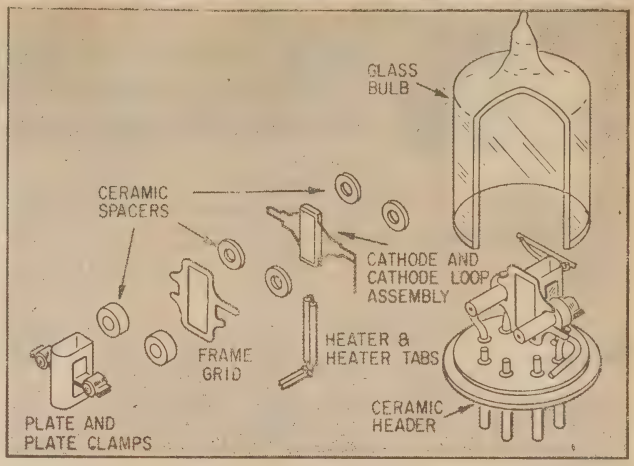
The front of the bass driver is open the same room into which the horn rks. This introduces impedance varia- ns which could result in peaks or dips response. In effect, there can be a t of acoustical short circuit, waves m the horn mouth cancelling (or re- forcing) those from the front of the ver.

E OF RESONATORS

To overcome these variations, each e of the speaker cone—where it works o the horn throat—is fitted with a all Helmholtz resonator (see the cut- ay photo), tuned especially for this eaker-horn parameter. The resonator ips to smooth out the peaks and dips. d eliminate them as factors in the re- onse. The resultant impedance curve ows a total variation of no more than to 1, which is obviously much lower n that in conventional speaker stems. Such a low variation has a tinct advantage as the terminating d for an amplifier, since it makes less mand on the complex of damping, bility, recovery time, power reserves d response throughout the audible nge. The HFS-2, consequently, can driven by good amplifiers of any wer rating.

—"Radio Electronics."

CERAMIC-GLASS VALVE ARRIVES



Using a ceramic mounting method for internal elements, a new type valve has been produced with a conventional type glass envelope. Valuable production advantages and great rigidity are claimed.

CERAMIC receiving tube developments of one manufacturer took off on a tangent two weeks ago when the firm announced it will produce a tube intermediate between conventional and advanced types.

Sylvania is taking its stacked mount and putting it in a conventional glass envelope. The mount will plug into standard sockets but was originally designed to go into a ceramic envelope.

The firm is one of several working on all-ceramic-metal receiving tubes.

The designs of some other experimental tal tubes also seem adaptable to glass envelops. This possibility was indicated in the AGET report and in a prior survey by Stanford Research Institute.

The compromise, according to one Sylvania source, forgoes some of the ultrahigh temperature advantages of ceramic envelopes. But it is said to yield these advantages:

- Solidity of the stacked mount—it vibrates as one piece.
- Glass envelopes can be exhausted and sealed with conventional tube-making machinery This allows mass production.
- Stack mounts lend themselves to automatic production. The mount structure readily allows dimensional control during assembly and is adaptable to available manufacturing equipment.
- Ceramic spacers do not out-gas at high temperatures.

USED FOR MISSILES

All-ceramic-metal tubes have been primarily developed for use in missiles and other demanding military applications. One reason the military has been reluctant to adopt them in standard equipment, it is reported, is bell-jar sealing methods employed with ceramic envelopes at present. The military is concerned whether sufficient quantities could be produced to meet emergency requirements.

A dual triode, a medium-mu double triode and a high-mu triode are available in new design.

Adaptation of an audio beam power pentode and an r-f pentode will be completed sometime later this year.

CERIUM RAISES SOLDER STRENGTH

SOLDERED joints subjected to heat and pressure are greatly strengthened when solder tin content is raised and a small amount of cerium is added, according to Batelle Memorial Institute tests sponsored by Tin Research Institute.

Thin sheet brass pressings were soldered to form boxes simulating auto radiators, in which difficult joint conditions are found. Steam pressure in the boxes was cycled from zero to 20 psi six times a minute.

When the box joints were soldered with 30 tin-70 lead solder, addition of cerium gave negligible improvements in strength. Average time to failure remained at around 1,500 cycles.

Boxes soldered with straight 70-30 solder withstood 4,960 cycles on the average. Addition of 0.05 per cent cerium metal raised average joint life to 11,494 cycles; 0.10 per cent cerium metal, 11,478 cycles, and 0.80 per cent cerium added as mischmetal, 10,649 cycles.

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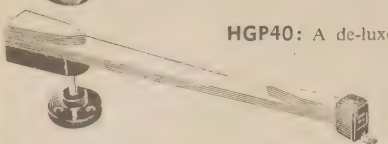
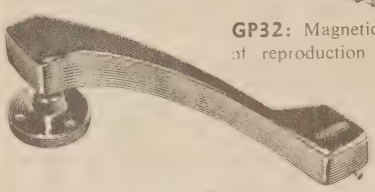


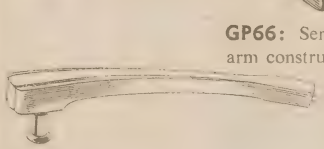
HGP40: A de-luxe crystal pick-up complete with separate standard and micro groove heads.

PRICE £9/15/0



GP32: Magnetic pick-up provides a good standard of reproduction with normal equipment at low price. Output voltage, ½ volt at 1,000 c.p.s.

PRICE £2/12/6



GP66: Series of lightweight pick-up with die cast arm construction increasing torsonial rigidity, minimising arm resonance. Complete.

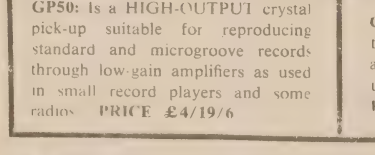
PRICE £5/7/6

HGP38: A crystal pick-up. Incorporates the HGP37 turnover cartridge for standard or microgroove recordings with cantilever stylus.

PRICE £5/15/0

GP50: Is a HIGH-OUTPUT crystal pick-up suitable for reproducing standard and microgroove records through low-gain amplifiers as used in small record players and some radios. **PRICE £4/19/6**

GP60: Incorporates the latest type CERAMIC cartridge—unaffected by heat or humidity. For use in tropical areas. **PRICE £6/16/-**



GP10: Is a crystal pick-up utilising the GP9 cartridge combining purity of reproduction with extreme reliability, resonance-free response from 50/8,000 c.p.s. Output 1.5v at 1,000 c.p.s.

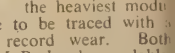
PRICE £3/12/6

HGP39 CARTRIDGE

Low element mass and very high compliance enables the heaviest modulation possible to be traced with a minimum of record wear. Both standard and L.P. heads available.

PRICE £3/12/6

GP9 CARTRIDGE



Famous as the cartridge with the unbreakable crystal. Takes standard steel or fibre needles for 78 r.p.m. records.

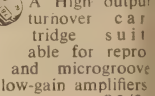
PRICE £1/11/6

GP59 CARTRIDGE

A High output turnover cartridge suitable for reproducing standard and microgroove records through low-gain amplifiers.

PRICE £2/3

GP61 CARTRIDGE



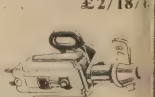
A Ceramic turnover cartridge that will withstand the the rigours of a tropical climate and is, at the same time, very robust. **PRICE £3/19/6**

HGP37 CARTRIDGE

A Crystal turnover cartridge with cantilever stylus that utilises a new method of crystal drive, a bisectional control element that achieves independent characteristics for standard and microgroove.

PRICE £2/18/6

GP65



Turnover crystal cartridges available in two types, medium output High Quality or High output with smooth well-balanced response.

BLACK SHADOW CARTRIDGE

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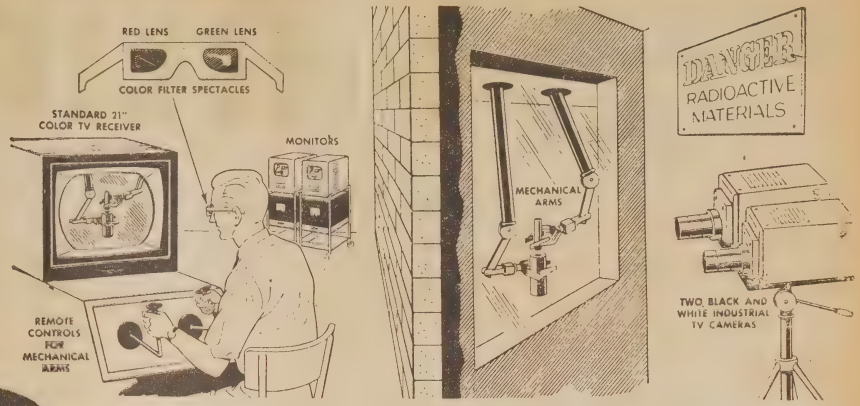


Two black-and-white industrial TV cameras (at right) focus on mechanical arms as they load radioactive material into container. Signals from cameras are applied to color TV receiver picture tube. A technician, in a safe area and wearing suitable glasses, uses the 3-D image to operate arms by remote control.

3-DIMENSIONAL TV SYSTEM

New closed-circuit system is all-electronic, uses standard camera equipment, and colour TV receiver.

THREE-DIMENSIONAL closed-circuit television systems are extremely useful for the routine observation of many processes and for the supervision of hazardous handling and control operations. Although various three-dimensional systems have been described, these systems depend either on mechanical devices such as rotating shutters or on complex photo-optical devices using polarised light and/or dichroic mirrors to provide stereoscopic viewing.

This article describes a simple, all-electronic, three-dimensional television system which uses standard camera equipment and a standard colour-television receiver.

It provides simultaneous presentation of the left and right images and permits stereoscopic viewing in either yellow or black-and-white.

TWO CAMERAS

The new system employs two RCA Type ITV-6 black-and-white television camera-monitor units as pickup devices and a standard commercial RCA 300-Series colour television receiver equipped with 21CYP22 colour picture tube as the display device. A video amplifier having flat response to 7 megacycles and a voltage gain of 140 is used between each camera and the 21CYP22. Observers view the simultaneous two colour display through spectacles equipped with two Kodak "Wratten" colour filters: No. 29 (red) for one eye and No. 61 (green) for the other.

The system is shown in the block-diagram form in Fig. 1. The two cameras are mounted on the same tripod, with the optical axes of their lenses in the same horizontal plane and having approximately the same separation and convergence as the average pair of adult human eyes. The right-hand camera, therefore, "sees" a subject as it would be seen by the right eye and the left-hand camera as it would be seen by the left eye.

The 21CYP22 is operated with normal electrode voltage and scanning, and standard procedure for static and dynamic convergence of the three beams is followed during setup of the receiver. The amplified output of one camera is applied to the red gun of the 21CYP22 colour picture tube in the receiver and the amplified output of the other camera to the green gun. The blue gun of the 21CYP22 is not used and is biased to cut-off. When the simultaneously displayed red and green fields are viewed through the goggles, they produce a stereoscopic subjective image in yellow.

The output of either camera chain may be applied to either the red or green gun of the 21CYP22, provided the relative positions of the red and green colour filters worn by the observer are the same as the corresponding cameras.

Each Type ITV-6 camera contains a complete sync-pulse generator which may be used as a source of synchronising pulses for the entire system. The unused sync generator is disabled. The composite video-modulated channel-frequency signals which are available at the "R.F.-Output" jacks on the monitor units simplify synchronisation of the receiver since these signals can be applied directly to the receiver antenna terminals.

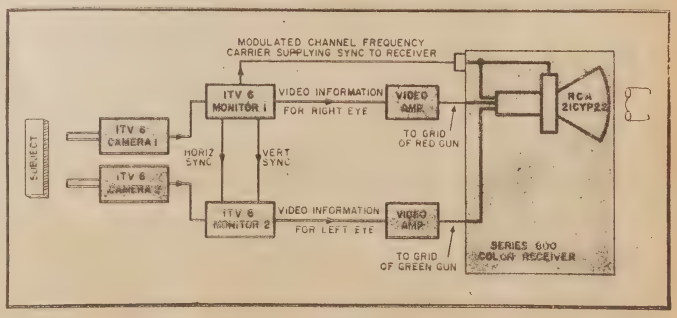
BLACK-AND-WHITE VIEWING

If black-and-white stereoscopic images are desired, the blue gun of the 21CYP22 can be driven in parallel with either the red or green gun to complete the required colour triad. Because the luminosity of the blue field is substantially higher than that of the red and green fields, careful adjustment of the drive to each gun is necessary to obtain the proper ratio of the three colour components.

If pictures of broadcast quality are

(Continued on Page 128)

Fig. 1. Block diagram showing operation of closed-circuit, three-dimensional TV system



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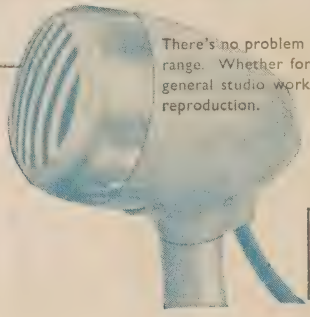
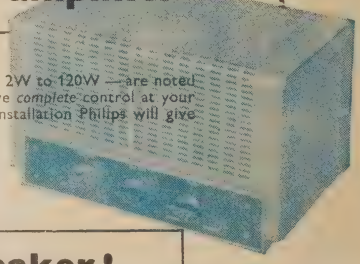
Philips make a sound system for EVERY situation . . . and you can completely rely on a Philips component — robust but compact, finely styled and precision built for high efficiency and simple operation.

from microphone —



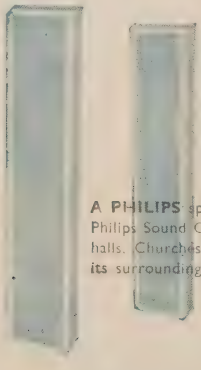
There's no problem choosing the microphone you need — from the wide **PHILIPS** range. Whether for hi-fi tape recording, P.A. systems, top quality broadcasting or general studio work the correct Philips microphone will give you perfect sound reproduction.

to amplifier —



PHILIPS standard range of tuners, amplifiers and boosters — from 2W to 120W — are noted for their strong but compact construction. With a Philips you have *complete* control at your fingertips. Whether you need a mobile, portable or permanent installation Philips will give you the utmost in reliability and performance.

to speaker!



A PHILIPS speaker gives "all round sound" with high quality directional properties. Philips Sound Columns in particular have overcome difficult acoustical problems in large halls, Churches, etc. A *Philips* speaker enclosure is attractively designed to blend into its surroundings.

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P862.58

NEWS AND VIEWS OF THE MONTH

Reading machine

SCIENTISTS are developing a portable device to enable the blind to "read" ordinary books and magazines.

The "aural reading machine" transmits sounds through photocells.

It allows a blind person to read normal print, including typewritten letters.

It is the size and shape of a portable radio and weighs about 9lb.

It produces sounds for the sightless not in the sense of actual words, but in musical tones similar to chords played on an organ.

With special training, a blind person could ultimately "read" at the rate of 15 to 30 words a minute.

This is the principle on which the device works:

A small instrument containing two tiny lights and a lens that projects an image of the printed letter on a row of photocells is passed over the printed material.

The device sounds a tone varying according to the "black" part of a letter scanned.

It transmits sound patterns which the blind "reader" interprets.

More development of the device and training techniques are needed before quantity production can begin.

(Picture this page.)

"Magic" French engine

A FRENCH heavy truck manufacturer claims to have developed a revolutionary low-consumption engine.

The company said the engine could run on any type of fuel, from crude oil to cod liver oil.

Called the "Magic," the engine had already run on lubricating oil, crude petroleum, olive oil, groundnut oil, cod liver oil and brilliantine.

New radar speed check

MARCONI'S are now producing the first radar speed check equipment to be designed and manufactured in Great Britain. The device is known as "PETA" (Portable Electronic Traffic Analyser).

"PETA" removes one of the major objections to the use of radar as a means of checking the speed of road vehicles even under conditions of dense traffic. It will provide separate readings on vehicles which are only 8ft (2.4 m. approx.) apart, and will automatically "lock on" to any individual reading if so desired. The speed range of the equipment is from 2 mph (3 kph) to 80 mph (129 kph), but this can be extended if required. The accuracy of speed assessment is within 1 mph (1.6 kph).

"PETA" employs the Doppler effect of frequency change, which occurs when electromagnetic waves are reflected from moving objects. This principle, in conjunction with the extremely narrow horizontal beam-width of the radiated signals (between 3 and 4), provides simplicity of design, portability and high accuracy of measurement, giving the user a device which calls for no technical skill in its operation. An extensive use has been made of transistors and printed circuits in order to achieve compactness and light weight. The complete equipment, which weighs only 21lb (9.5 kg), consists of a transmitter/receiver unit with its associated aerial and meter unit.

The potential uses of "PETA" are by no means confined to the operation of speed checks. By the use of a 35 mm camera attachment and an analyser unit which is in the course of development, a record can be provided of the speed and frequency of traffic at any particular road point.

This aural reading machine converts the shape of letters printed on a page into electrical currents via photo cells and thence into sound. Trained users should eventually reach 15-30 words per minute.

Bouncing from the moon

RADIO transmission tests using the moon as a passive relay station have been conducted recently by the Signal Communications Department of the U.S. Army Electronic Proving Ground and Collins Radio Company.

These tests very probably represent the first time that intelligence, in this case by radioteletypewriter, has been transmitted in the ultra-high frequency region of 1,000 megacycles over the nearly 500,000-mile distance from the earth to the moon and back.

Transmitting station for the tests was located near Fort Huachuca, Arizona, and the receiver was at Encino, New Mexico. The frequency of 810 megacycles per second was utilised in order to increase the effectiveness of the antenna systems and to take advantage of lower signal losses in the transmission path.

During November, 1952, Collins and the National Bureau of Standards used the moon as a reflector to relay radioteletypewriter signals from Cedar Rapids to Sterling, Virginia. In the Collins-NBS tests, an ultra-high frequency of 418 megacycles was used.

In discussing the current tests, project personnel at Fort Huachuca said this type of communication is limited in range only by the ability to observe the moon simultaneously from both the transmittting and receiving points. Some appreciation of the distance involved in this method of communication can be obtained from the fact that a signal, travelling at approximately 186,000 miles per second, requires only 2½ seconds to travel the path from the transmitter to the moon and back.

If an artificial satellite can be utilised for this method of communication, the time of transmission and losses can be drastically reduced.

Japan backs transistor

THE transistor radio set in Japan is the forerunner and probably the most rapidly spreading product of a new science and new industry.

Japan regards it as a "hope" among Japan's exports, as the Japanese-made camera has been.

The tiny and lightweight transistor radio set is replacing the conventional radio of vacuum tubes and the ordinary portable radio.

Transistor radios represent 87 per cent of the total production of sets in Japan, compared with 14 per cent in February, 1957.

The production in one month this year totalled 159,000 units against 30,000 units of conventional radio sets.

The present production capacity is 30,000 units monthly.

During the period April, 1957, to March, 1958, Japan exported 363,000 transistor radio sets worth 5,645,000 U.S. dollars.

Of the total, 70 per cent went to the United States and Canada.

Domestic prices have decreased to as low as 9,000 yen (£9 sterling) from the original 15,000 yen (£15).

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Radiation keeps food

STEAKS good for a year and hamburgers which can be cooked 10 months after purchase will be on sale in the U.S. within 10 years, food experts say.

The food would be treated with radiation, a new technique for preserving food pioneered at the Massachusetts Institute of Technology under Professor Bernard Proctor.

Already slices of beef treated with the technique have been stored for more than three years and are still edible.

The U.S. Army is building a new radiation-preservation centre at Stockton, California, and will shortly begin field tests of irradiated food at Fort Lee, Virginia.

Radiation would not supplant canning or do away with freezing.

It would rather supplement refrigeration and allow for longer storage of foods at refrigeration temperatures above freezing.

Space flight diet

SPACE travellers of the future may live on water-grown plants and shellfish, according to Soviet scientists.

The scientists are working on medical problems relating to space flights.

The report, quoted by the official news agency, Tass, said that algae, containing a large quantity of proteins and polluses from which highly nutritional fat can be obtained, had been grown in the specially-equipped rooms of a laboratory simulating the conditions on space ships.

It had been established that about 44 gallons of algae could be grown in a rocket—enough to feed one man for six months.

Atom train

THE Soviet Union is planning to put an atom-driven passenger train into service between 1960-1965 which would reach speeds of 312 m.p.h., according to the Hungarian newspaper, "Magyar Ifjusag."

The Russians planned to put the train in regular service between their East and West borders.

It would make two round trips without requiring refuelling.

Colour vision

IT has generally been thought that a person's ability to distinguish between different colours was fairly stable throughout life. Some experiments undertaken by the Applied Psychology Unit of Edinburgh University show that this is not the case.

R. Lakowski described the results of a survey of 500 people, half men and half women, which showed that colours are perceived more readily and most accurately by subjects between 16 and 35 years of age. Children and older people are less good at colour discrimination, and above the age of 55 colour discrimination appears to deteriorate very rapidly.

The deterioration in ability to discriminate between different colours sets in at different ages for different colours. Yellow-blue and violet-blue/green discrimination deteriorates in some subjects as early as 30 years of age.

On the other hand, red-green discrimination is much more stable and only in the oldest group of subjects (over 55), was poor, red-green discrimination as high as 30 per cent.

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4"	21020-4PU/15	15	180 - 20	7500	4.0	£2 2/8
5½	20861-5PW/3	3	135 - 15	5000	5.0	£1/13/6
5½"	21186-5PU/15	15	135 - 15	5000	5.0	£3/10/6
6½"	21069-6PU/3	3	125 - 15	6500	4.5	£2/6/0
6½"	21166-6PU/15	15	125 - 15	6500	6.0	£2/6/0
7" x 5"	20944-7PU/3	3	115 - 11	5000	5.0	£2/11/0
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7"	21253-7PT/3	3	120 - 10	5000	5.0	£3/1/0
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9" x 6"	20946-9PS/3	3	115 - 11	6500	6	£3/10/6
9" x 6"	21169-9PS/15	15	115 - 11	6500	10	£3/10/0
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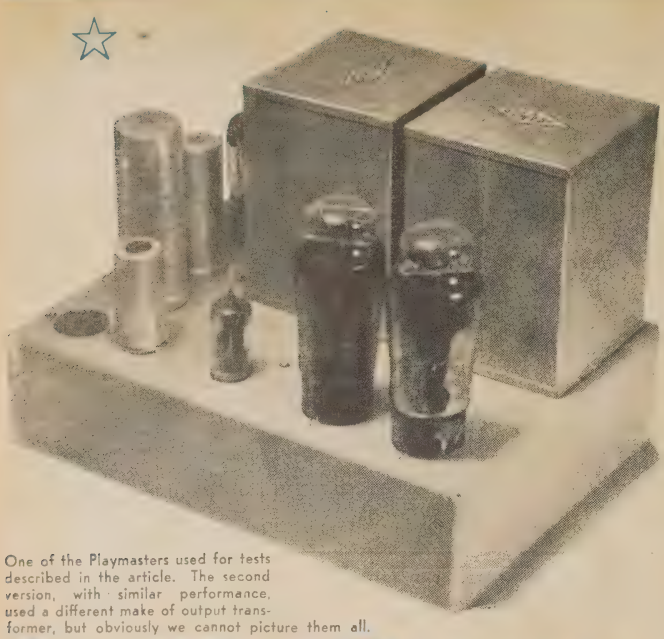


One of the Playmasters used for tests described in the article. The second version, with similar performance, used a different make of output transformer, but obviously we cannot picture them all.

Amplifier Response Stability & All That

This article discusses the effects of the output transformer on some aspects of amplifier performance with particular reference to high frequency stability. It deals mainly with practical results, and includes the evidence of tests made with typical commercial designs and one of our own.

by John Moyle

PERHAPS the most puzzling thing about amplifiers, at least to the man who wants one, is the very great discrepancy in the behaviour and specifications of many designs, all of which may be good, and the product of well-informed engineers.

In the matter of power output there is not a great deal of difficulty, for, although there are differences of opinion as to how much power is needed for home use, the user of an amplifier can please himself about the amount of power he elects to use.

But in many other matters he may well wonder just where he stands.

Frequency response is perhaps the one single specification where great variation can be seen. Some amplifiers with famous names commence their high frequency attenuation as low as 10 kc, with a 3 db loss at perhaps 25 or 30 kc. Others run well over the 100 kc mark before this point is reached. Some very few will exceed even this figure—we have made them ourselves.

Distortion, too, varies a great deal if we can believe the data sheets. Most of the better type will claim down to .1 per cent at substantially full output, and some even better. Others are satisfied with a figure higher than this.

Some pay great attention to the amount of intermodulation distortion they are able to quote—others leave it out altogether.

Then there is the matter of stability, about which nearly all amplifier specifications are dumb. Sometimes we find statements that a certain design will stand an extra 6 db feedback without oscillation, and some such figure is given as a stability margin. Very few will specify the conditions under which such a test would be made, which detracts almost wholly from its value.

How is it, then, that with the same object in view—a performance which can be considered more that adequate for the reproduction of music—ideas and results vary so greatly?

An obvious conclusion which can be gleaned from all this is that there are no recognised standards by which an amplifier can be judged.

It is true that many tests have been made by those interested in the field to determine how much distortion can be considered permissible in listening tests, but even these do not agree. Moreover, they are all the more difficult to rationalise because they depend greatly on the type of input used, whether simple or complex wave-form, the frequency response of the equipment, the age and even sex of the listeners and so on.

And it's a horrible truth that some amplifiers which do not produce the very best figures sound very well indeed: virtually indistinguishable from others which show very much better test results.

BEST DESIGN

We can't seriously disagree with the idea that the design which has the flattest frequency response, the lowest distortion, the most uniform power curve, the highest degree of stability and so forth will be the best amplifier, even if its results are patently beyond those ever the most fastidious could require for use with gramophone records.

But, how much poorer could such an amplifier have been in its various qualities before the listener would detect a difference? That's the heart of the matter as far as the user is concerned.

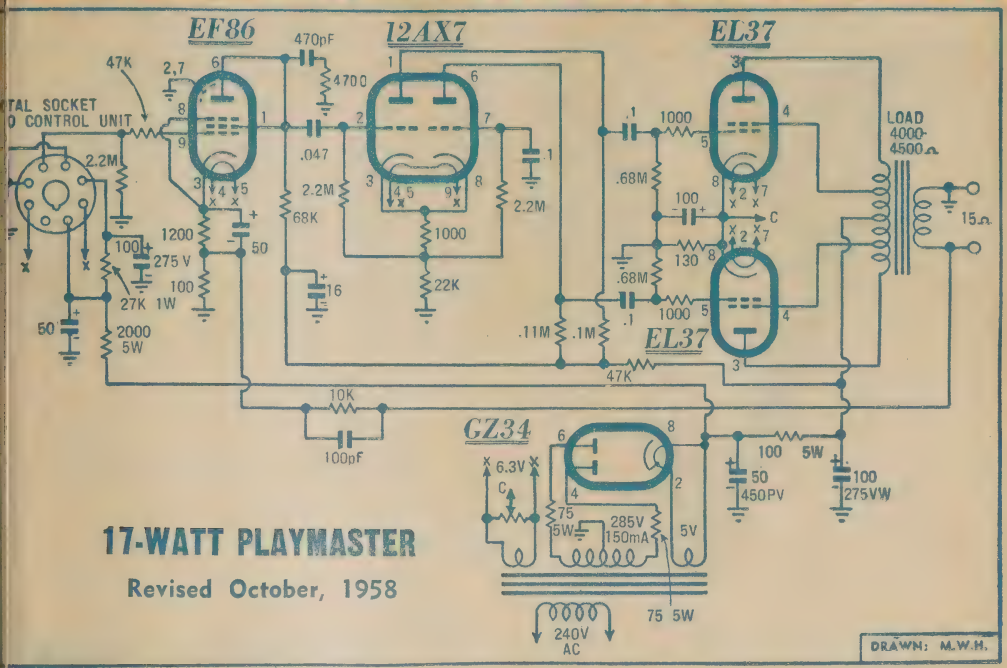
Without doubt, if cost is no object, the designer's work is made very much easier. If a high-priced outfit is able to boast of supersonic specifications, we can't blame the manufacturer for claiming them. Nor can we blame his competitor for trying to do equally well even if he has to sacrifice some desirable feature to achieve another which looks more impressive on paper.

The man who has a cheaper and less spectacular unit for sale, may well wring his hands, particularly as he often knows that the listener might not be able to distinguish between his product and one much more costly.

One of the difficulties we face when trying to be specific about these matters is the lack of exact knowledge about the nature of the input our entire system is expected to handle. And, in this respect, the nature of anticipated transients is as obscure as any.

In checking amplifiers, a squared wave at 5 kc is often accepted as an excellent thing to test the behaviour in the high frequency region, mainly because its sharp, vertical component is well suited to demonstrating performance under the attack of sharp wave-fronts, and beam

PLAYMASTER MODIFIED FOR EXTREME STABILITY



The 17-watt circuit showing addition of step circuit. It is not essential to stability on any form of normal loading. The grid stopper is a precautionary addition, found necessary only when test leads were connected and the critical capacitance added to the load — a condition most unlikely in actual use as our test wave forms demonstrate.

shows up probably better than any ther method the degree of ringing and vershoot suffered by the amplifier.

Most such square waves have a very harp wavefront, representing a rise time voltage from zero to maximum of erhaps one microsecond, or even less. he application of such a wave-form ith a 5 kc fundamental is a very severe st.

It is virtually certain, however, that o input we are likely to use in practice an possibly include such a fast rise-time. /e are not immediately concerned with ne characteristics of the wavefront as exists in nature, for, even supposing here were sounds generated having this haracteristic, they would suffer very onsiderable attenuation before the amlifier eventually received them.

RECORDING PROCESS

The very process of recording means hat the wave-form must pass firstly hrough a considerable amount of air, hich will be responsible for apprecible attenuation of such wavefronts. ven over comparatively short distance. hen we have a microphone, numerous mplifier stages, an entire recording and eproducing system with tape, more amlifiers, a cutting head, and, finally, a ecord manufacturing process with many amping cycles. Finally there is a ick-up and a set of loudspeakers.

If the tape itself is to be played, e can eliminate some of the intermedite steps, but the damage will have robably been done long before this.

If we relate the probable fastest rise time to these matters, and the frequency response of the system, we might estimate a rise time of 30 microseconds as being a very good standard.

Recording engineers are not very helpful when asked to confirm such figures, which is understandable because it would be a very difficult task to perform with any degree of accuracy.

Perhaps it is fortunate that we can frequently make amplifiers which test very well under our severe conditions, and we can't deny that they are more likely to give good results than those that do not show up so favourably.

In effect, this principle seems to be the basis upon which the average amplifier designer operates. Knowing the amount of money which can be spent by the factory, he collects together all the desirable things he would like to achieve, and then does his best.

And, when surveying what these results are likely to be, it is obvious that by far the most vital component of all is the output transformer.

The almost universal use of transformer coupling is fairly solid evidence that it provides the most useful method of coupling the output valves to the loudspeaker. There is a considerable impedance difference existing between these two essentials, and although circuits have been devised and used more or less successfully which avoid the transformer, they have difficulties of their own which in most cases outweigh their advantages.

And the fact is that it is possible to make very good output transformers, more than adequate for the work they are called upon to do.

Nevertheless, while we use transformers, we must be aware of their characteristics and how they affect amplifier performance.

The main points in which we are vitally interested concerning transformers are their influence on frequency response, power output at various frequencies, and, in feedback circuits which are now universal, stability and freedom from oscillation.

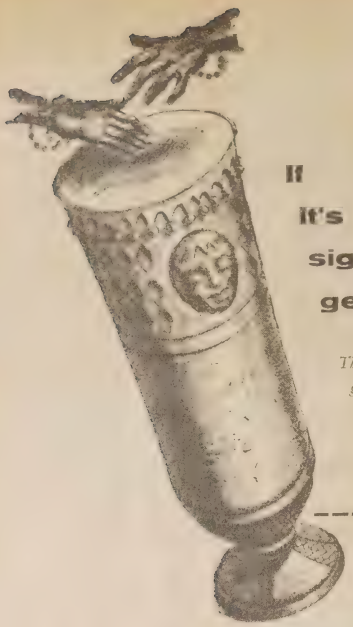
There are other points to be considered, of course, such as distortion, and it is true to say that all such factors must be considered together when working on design.

All these points are also affected by amplifier circuit design, but in the process of development and experiment, all the standard types of amplifier circuits in common use give roughly equivalent results, at least until the finer points of performance are concerned.

AVERAGE CIRCUIT

The average amplifier of today has three stages — a voltage amplifier, either a pentode or a triode, a phase changer, either the plate cathode type or some version of cathode coupling (a few use paraphase circuits) and a push-pull output stage with an ultra-linear connection. In most of the good quality amplifiers we have tested, little performance variation could be traced to circuitry.

Provided the valves are operated in the



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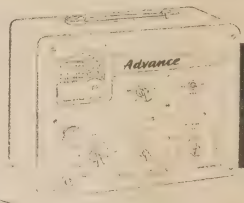

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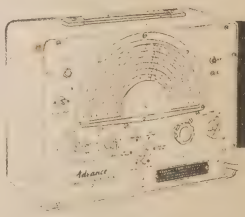

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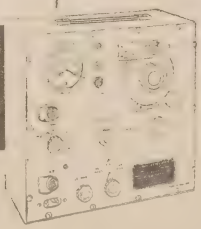

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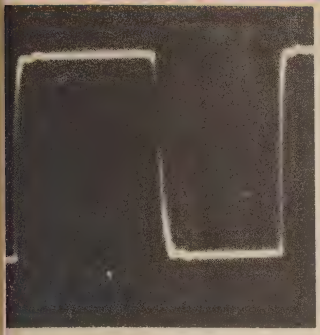
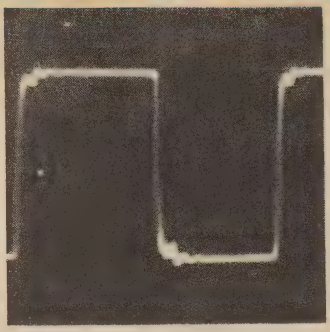
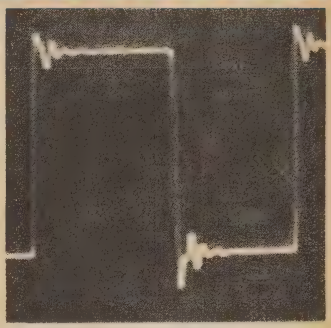
TEST WAVEFORMS OF COMMERCIAL AMPLIFIERS



Amplifier No. 3 on 15 ohm resistive load. Not bad, but ringing extends along vertical line, a suspect condition.



Amplifier No. 1. on 15 ohm resistive load. Multiple ringing well damped with rounded corners.



Amplifier No. 1 on open circuit. Ringing and overshoot have noticeably increased but under control.

ost linear fashion practicable, are not quired to deliver output beyond the aker's ratings for low distortion or herwise abused, their total contribution distortion is well under control.

The transformer itself also contributes small amount of distortion, but the fact at the overall figures given by an intel ent hook-up are very small, is enough r us to leave the question at is point, except as it is affected other considerations in which we are terested at the moment.

The almost universal practice of inding the output transformer in a gative feedback loop referred back to input circuit is the most effective y of dealing with over-all distortion. h with an easily obtainable 20 db of dback, distortion is reduced to about e-tenth of its previous value. It is most helpful factor in dealing with kinds of distortion generated within amplifier.

It is also almost entirely responsible the frequency response and stability the amplifier, and mainly through se two, the square wave performance transient characteristics as well.

OWER OUTPUT

The amount of power obtainable from transformer at low frequencies deends primarily upon the amount and ade of iron used for the core. The west frequency which will be reproced without loss is a function of the ductance of the primary winding as ferred to the output load required by valves. Because the transformers' size st be reasonable, there will be a fall- off in both power handling and freency response beyond some given int, and a natural droop in the transrmer curve.

At the high frequency end there will o be a drop in frequency response e mainly to the self-capacitance of windings which acts as a high freency bypass and inefficient coupling tween windings. This attenuation n commence well within the limits of dible response unless great care is en to minimise both sources of loss. ctionalised winding is the universal thod of doing this, but, even so, all nsformers will behave in this manner. As such, the frequency response of the amplifier would be very poor by modern standards without the application of negative feedback.

Negative feedback is a gain-reducing connection, and, because the amount of feedback will depend on the amplification of the amplifier at any frequency, it will be least at frequencies where the gain is lowest.

EFECT OF FEEDBACK

If, for instance, we have 20 db of feedback at 1 kc, we will have a gain reduction of 10 times at this point.

But if we select a frequency at which the amplification without feedback is only half of that at 1 kc, the feedback will also be halved, and the over-all amplification reduced by only 5 times.

We can thus consider feedback to act as an automatic gain control, and the more of it we use the more will it flatten out a response which originally drooped at both the high and low end of the spectrum.

Were it not for other factors which raise their ugly heads as we pile on the feedback, there would be virtually no end to the process, and quite poor transformers would give very flat responses so long as the initial drop in over-all gain could be accepted in the design.

It would be most convenient if output transformers were to fall smoothly away at each end of the frequency range, but they do not. Particularly at the top end we find peaks and troughs developing in the response as feedback is increased, and, at some stage, the amplifier will oscillate, the frequency of oscillation being at some point almost always outside the audible frequency band.

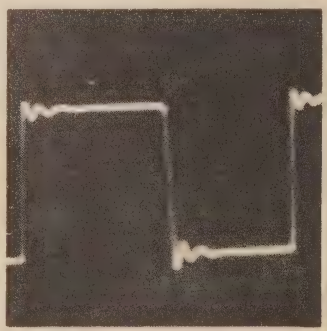
According to the transformer characteristics it might be anywhere between about 30 kc and 500 kc.

The oscillation is due to a change in the phase relationship between the input voltage and the feedback voltage. Ideally this should be completely negative all the time, which means a phase difference of 180 degrees.

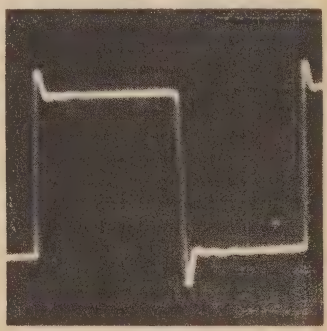
OSCILLATION DANGER

But, if a response peak should appear in the curve, instead of a negative feedback at this point it is possible to have a positive feedback. When this happens, we have not degeneration, but regeneration, and consequently oscillation or the danger of oscillation.

Two points should be remembered here. The frequency and amplitude at which these peaks occur is largely governed by transformer characteristics. Feedback does not materially alter their frequency, but it increases their ampli-



Amplifier No. 4 on 15 ohm resistive load. Ringing is pronounced and regular in frequency.



Amplifier No. 4 on open circuit. Ringing is less but overshoot peak emerges. Load capacitance would increase this.

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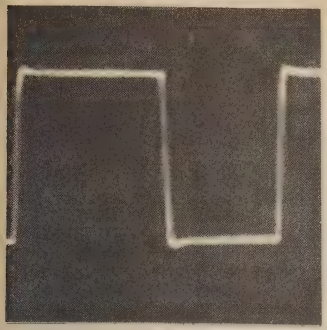
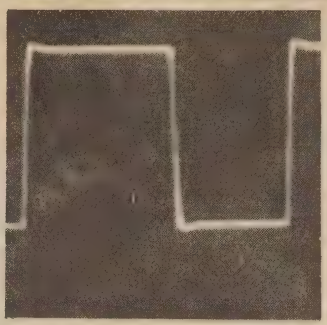
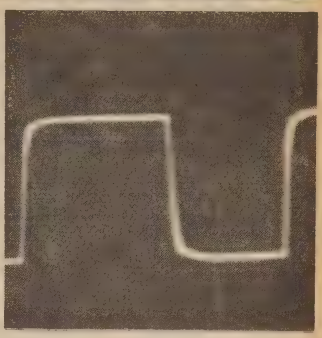
TEST WAVEFORMS OF 17W PLAYMASTER CIRCUIT



Playmaster with 3 section crossover, indistinguishable from waveform on 15 ohm resistive load. Negligible ringing



Playmaster on open circuit. Almost identical with that of previous photograph.



Playmaster on 2 ohm resistive load. Even on this extreme waveform is still free from major faults.

tude very greatly, for it is at these points that feedback is lessened because of the positive-moving phase shift. The more feedback we apply the higher the gain will rise at these resonant peaks, where feedback may be removed altogether.

What causes these peaks in transformer response?

They are caused by a resonant circuit or circuits consisting of the self capacitance and leakage inductance of the windings or even sections of the windings (an inductance representing coupling losses between primary and secondary) These resonances generally occur at response points where, without feedback, the amplifier gain has fallen considerably due to transformer limitations, and they will not cause oscillation unless some unscheduled feedback paths exist. But in an amplifier with negative feedback, we have ourselves provided the means by which undesirable phase relationships may take place, and oscillation will occur as soon as the peaks become sharp enough unless steps are taken to avoid it.

TRANSFORMER TYPES

If the transformer is of the simple type, with few winding sections, and comparatively loose coupling between primary and secondary, a resonance peak may be found at one frequency only, of high amplitude, and probably about 50 kc.

In a more elaborate transformer, with many sections, and more efficient coupling, it is probable that more than one peak will be in evidence, at frequencies varying from 150 kc to 300 kc, and of considerably lower amplitude. However, there is no general rule about this —the control of resonances is part of the manufacturer's art, and transformers vary so much in characteristics that it is almost impossible to set circuit values which will give optimum performance from them all.

As a general rule, transformers with a high amplitude peak anywhere in their response curves can only be used with limited amounts of feedback without oscillation. Corrective methods inevitably degrade both frequency and square-wave response, but generally speaking it is best to move the peaks as high as possible and to keep their amplitude low. This means that corrective measures need concern only that portion of the response above the point at which they commence, and with a good transformer this can be as high as several hundred kilocycles.

Nevertheless, with large amounts of feedback, we cannot be certain of complete stability without loss beyond about 50 kc, even with transformer peaks which occur far beyond that point.

CORRECTION METHODS

So complex is the calculation of transformer design of this nature, particularly as cost and manufacturing processes must be considered, that most units are the result as much of experiment as of mathematics.

This is also true of the corrective methods which can be used, and the manner of their application. It is possible to forecast them only within certain broad limits — beyond these individual adjustment is the only certain method without a certain amount of brute force.

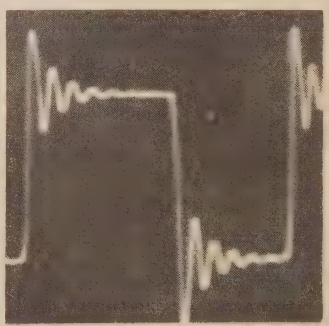
For this reason, amplifiers which use feedback of the order of 20 db or even more, inevitably use correction methods quite freely, and quite often exhibit the poorest frequency and square wave characteristics.

However, these are generally still well within what we may consider high limiting standards—which is where we came in!

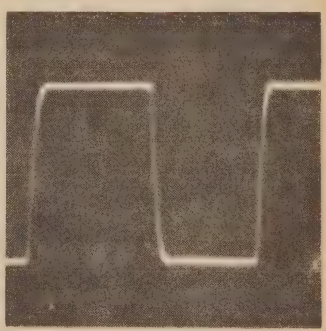
A stable amplifier is not merely one which does not exhibit continuous oscillation. Any resonant condition, if not corrected, will cause "ringing" or damped oscillations over portion of the audio cycle if excited at or near its resonant frequency. Square wave tests to simulate input signals with steep wave fronts are very useful to detect this condition, which will show up as a damped oscillation on the flat top of the waveform. Nearly all amplifiers will ring to some degree even when corrected, and this is not particularly significant provided the ringing amplitude and duration are small.

USE OF SQUARE WAVES

Steep-front square waves will generally show up the ringing to best advantage because the frequency components of such a wave include very high frequencies likely to be at least equal to and probably higher than the resonance frequency. If more than one resonance is present, the ringing will have an irregular periodicity; if one resonance peak predominates it will probably swamp the others and show up as a regular superimposition. By observing the ringing characteristics, a great deal can be learned about the transformer resonance, and this information can be cross checked by a frequency run of the amplifier to observe the various peaks the



Playmaster with crossover and added .5 mfd capacitor. Note how this induces ringing on otherwise excellent waveform but as yet no instability.



Playmaster with 10Kc square wave and cross-over network. Virtually the same as with 5 kc as used with remainder of photographs. Slope of verticals mostly due to the generator and CRO.

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esult of which is displayed by the square ave method.

There are two standard methods of orrection applied to amplifiers to improve stability and reduce ringing.

Because the presence of a resonance eak is due primarily to removal or reuction of feedback as a result of positive going phase change, a capacitor cross the feedback resistor normally onnected from the voice coil circuit to e input of the amplifier can be selected modify the feedback at the resonance oint and beyond.

The effect of this capacitor is quite ramatic in its results.

It is most effective when a single reonance peak predominates, and will ften remove a pronounced ringing conition to little more than a small wriggle the commencement of the square wave ace.

It can be fixed also by first locating e frequency at which the peak occurs. nd selecting a value which removes or reatly reduces the response peak.

Almost invariably the two methods will ross check.

It is obviously not practicable to hase out" more than one peak by this ethod, unless there are several quite osely spaced. This is generally not the ase, but fortunately the others will be f a small amplitude in a good transormer.

Nevertheless they can be sufficient to ause positive feedback if large amounts f feedback are used, or if we insist on esting for stability under every conceivable load condition, each one of hich will vary the characteristics of the eedback circuit because of its intimate onnection to the voice coil, itself a sentive point in the feedback loop.

USE OF ROLL-OFF

If this should be the case, the only easy dditional method, having done what may e done to vary the feedback factor, is to lter the rate of amplifier attentuation or roll-off" by means of a capacitor to round, usually wired at the plate of the rst valve in the amplifier.

This method will so reduce amplification in the region of danger that neither mplifier gain nor feedback is significantly high enough to cause trouble.

If the amplifier has a single resonance eak fairly low in its range — between 00 and 200 kc for instance, a simple apacitance to ground will probably be ufficient.

And because the presence of this apacitor also affects the feedback at this oint, it will be necessary to revaluate he capacitor across the feedback resistor or best results.

But if the amplifier initially has a very ide bandwidth — significant up to 300 r 400 kc as can happen, a step circuit ill probably be best to attenuate the esponse in the danger region, and allow to flatten out again at the extreme top nd.

A combination of these two methods ill probably produce the maximum of ability together with the widest reponse.

If the amplifier should not be amenble to delicate placement of this capacior or step circuit, then a more severe ttenuation will probably be necessary nd a 3 db point at about 30 kc must be ccepted.

It cannot be stressed too greatly that he foregoing represents only a general escription of ways and means in popular use, and that there are almost as many variations possible as there are transformer types produced. "But the pattern is there, not only in our experience, but in the observation of numerous commercial amplifiers which we have checked and examined.

It might be profitable now to set down some of the results of this process, and see if some practical application can be extracted for the guidance of those who build their own.

The first amplifier was a costly job with an output over 20 watts. Its frequency curve showed a flat response to 35 Kc, plus 2 db at 65, zero at 95, minus 2.5 db at 115, plus 3 db at 150, zero at 185, minus 3 db at 200, minus 6 db at 225 and minus 12 db at 250.

DESIGN PATTERN

It used feedback compensation and a step circuit, so that an obvious attempt had been made to control multiple resonances throughout the response, not surprising as the output transformer was more complicated than usual.

The presence of peaks and troughs in the upper response made some ringing probable, and square wave tests showed its presence to a moderate degree and with irregular periodicity.

Tested on 2 ohms, 15 ohms, 15 ohms plus capacitance and open circuit, this amplifier did not oscillate.

It was also stable on a three-section divider network with any added capacitance, although very near oscillation with an added .5 mfd as indicated by severe ringing.

The second amplifier was also a high-powered costly design, but its characteristics were quite different. It was flat up to 10 Kc where a drop of 3 db was measured. It then rolled off smoothly — .7 db at 20 Kc, 2 db at 45, 3 db at 65, 6 db at 100 and 12 db at 135 Kc.

This smooth roll-off suggested a good square wave response with probably some drop in the leading edge, which is just what was found. Otherwise the waveform had a flat top with virtually no ringing. As was again expected, it was quite stable under any kind of load as used for Amplifier No. 1.

This amplifier used correction across the feedback resistor and a small capacitance to ground from the first valve plate.

Removing the correction components revealed a large peak at about 150 Kc and considerable ringing on 5 Kc square wave. Reconnecting the plate bypass removed this peak, but provided a smaller one at about 80 Kc. The feedback correction capacitor wiped this peak, and the response was then as already indicated. An excellent example of intelligent design which, despite its comparatively early roll-off, sounds extremely good.

This amplifier was not available for the divider network test, but it would probably have been stable.

The third amplifier was lower-powered, and commenced its roll-off at 20 Kc where it was down .7 db. Then followed minus 1 db at 30 Kc, 2 db at 50 Kc, 3 db at 65 Kc, 6 db at 82 Kc, 8 db at 110 Kc, 8 db at 125 Kc, and 12 db at 250 Kc.

Although the square wave performance was quite good, with some rounding off at the leading edge, this amplifier on resistive load showed some oscillation bursts at full output below 100 cycles, and became unstable with 15 ohms resistive load plus .002 mfds. and above. This result could be suspected from the "flat spot" between 110 and 125 Kc, indicating that the transformer probably had resonance effects in this region which, despite a step circuit connected to the first amplifier valve, had not been adequately dealt with.

NOT STABLE

This amplifier oscillated on speaker load with 30ft of twin flex lead and no extra capacitance.

The fourth amplifier was also a lower powered job, flat to 10 kc but with a rise of .5 db at 20 kc, 1 db at 35 kc and 3 db at 80 kc. It fell to zero at 115, minus 3 at 150, 6 at 180 and 12 at 250 kc. It used both feedback correction and a step circuit.

The square wave showed some ringing, but on 15 ohms the amplifier was stable. It had several impedance tap-

(Continued on Page 111)

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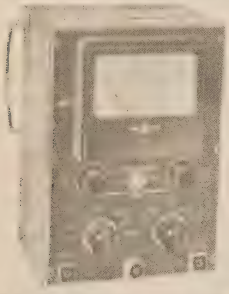

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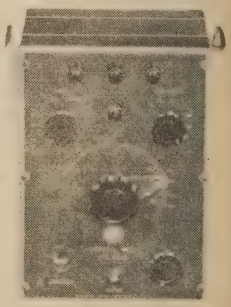

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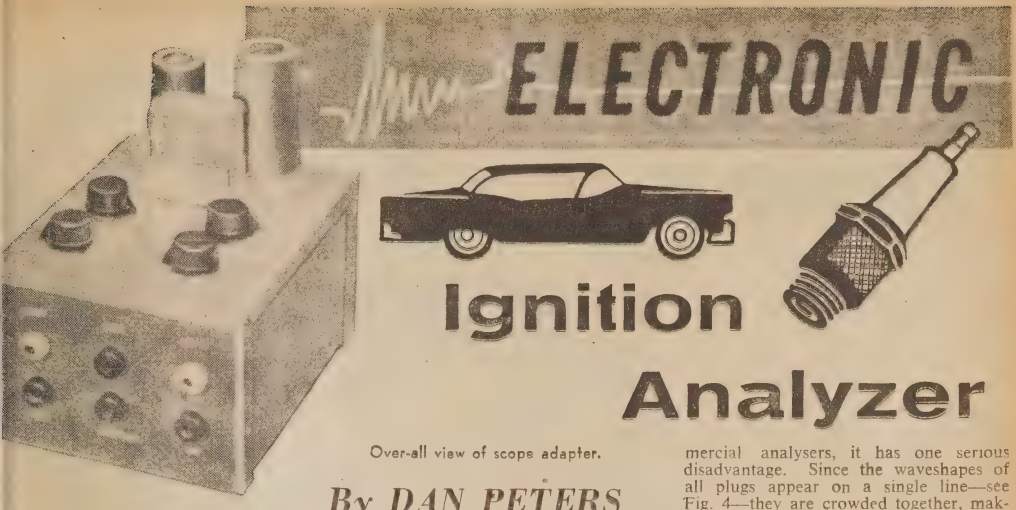

Over-all view of scope adapter.

By DAN PETERS

A description of a simple adapter for use with an oscilloscope to allow you to check on your car's ignition system. Article by arrangement with Radio & Television News.

THE modern automobile carries beneath its hood a gasoline engine ...ffected to a high degree of refine...ent when compared to its ancestors. ...parallel, although slower, development ...s been the improvement in ignition ...stems to meet the severe demands ...aced upon them.

Unfortunately, however, the test ...ethods used by most ignition me...anics have not progressed nearly as ...uch as the ignition system itself. ...If it were possible to view the voltage ...aveshapes existing in the system, much ...uld be learned about its operation. ...n oscilloscope is the classic tool for analysing pulse waveforms and seemed the logical choice for ignition analysis.

As a first attempt, the vertical input to the scope was connected, through a capacitive voltage divider, to the output of the ignition coil, as shown in Fig. 1. The voltage waveform applied to the spark plugs was thus seen stretched along the scope face. Applying an external synchronising voltage to the scope from the No. 1 plug assures that this plug will always appear at the beginning of the trace. This enables ready identification of all plugs.

While this system provides much of the information supplied by the commercial analysers, it has one serious disadvantage. Since the waveshapes of all plugs appear on a single line—see Fig. 4—they are crowded together, making analysis difficult. After a brief discussion of auto ignition fundamentals, the author will describe a simple scope adapter which places the waveform of each plug on a separate line.

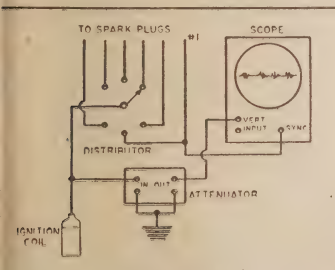

Fig. 1—Connections for oscilloscope.

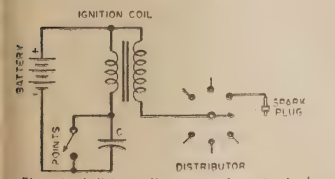

Fig. 2—Wiring diagram of a typical automotive ignition system.

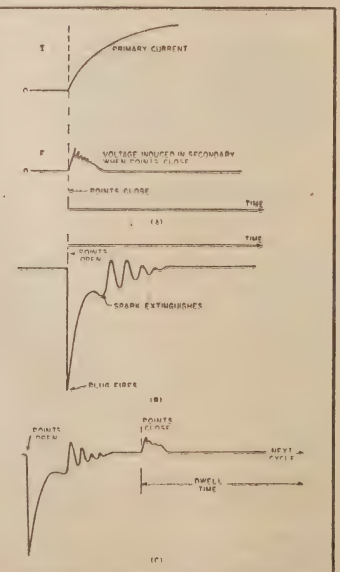

Fig. 3—(A) Points closed and (B) opened. (C) One complete firing cycle.

The wiring diagram of a typical automotive ignition system is shown in Fig. 2. When the ignition points close, the current through the coil primary builds up exponentially, as in any RL circuit. See Fig. 3A. At the instant of point contact a slight oscillation appears in the coil secondary. This oscillation serves no useful purpose in the ignition cycle.

The value which the primary current reaches depends upon the battery voltage, the resistance in the circuit, and the length of time the contacts are closed. The last factor is one reason that ignition performance decreases as engine speed increases. At the high rpm's, coil current does not have time to reach an amplitude sufficient to produce a hot spark.

POINTS OPEN

When the points open, the magnetic field about the coil suddenly collapses. The rapidly changing magnetic field induces a very high voltage in the many-turned secondary of the coil. A high voltage is also induced in the primary and it is one function of the capacitor to delay the build - up of voltage across the points. This gives the points a chance to open wide enough to prevent destructive arcing.

When the voltage becomes high enough (Fig. 3B) to cause arcing at the plug, the current through the plug loads the secondary and the voltage drops to a lower value—where it stays until the energy in the coil has dissipated to a point where it is no longer sufficient to maintain an arc. Once the arc is extinguished, the remaining energy is dissipated (in circuit losses) in the form of damped oscillations.

The cycle is repeated when the points once again close. Fig. 3C shows a complete ignition cycle.

After building several adapters designed to place the waveform of each plug on a separate line, the system shown schematically in Fig. 7 was

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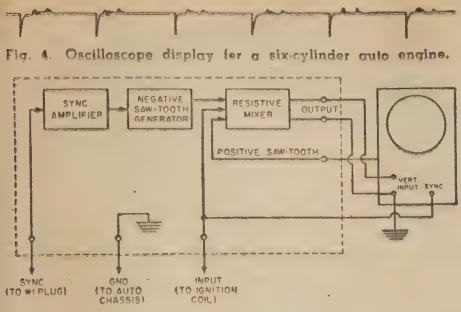


Fig. 4. Oscilloscope display for a six-cylinder auto engine.

Fig. 5—Adapter block diagram and the scope interconnections.

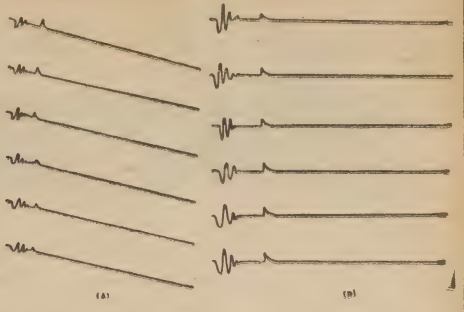


Fig. 6—(A) Uncorrected and (B) corrected 6-cylinder pattern.

ected as the simplest and most rkable.

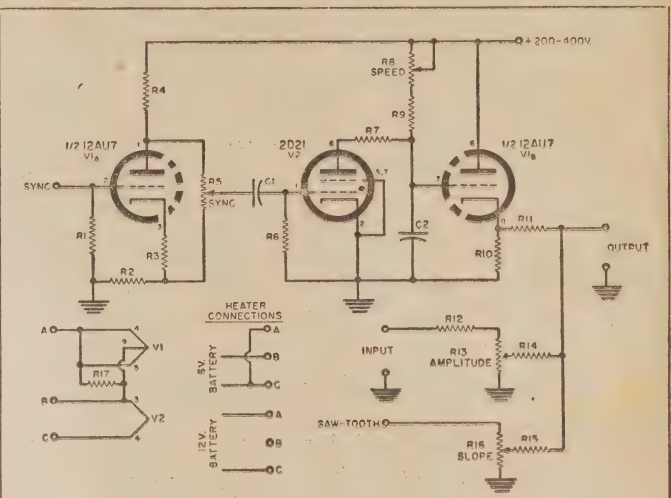
The block diagram of Fig. 5 will ve to illustrate the principle of operan. In use, the oscilloscope is nchronised to produce a sweep every ne the points open. The signal from e coil is passed through the mixer to e vertical input of the scope. This rangement would result in the veforms of all plugs being superposed if it were not for the negative w-tooth also applied to the mixer. is saw-tooth is synchronised with the , 1 plug and thus repeats once each gine cycle, or 720 degrees. Fig. 6A ows the resultant waveform for a six-linder engine. The downward slope n be removed by applying a third nal to the mixer. This third signal a positive saw-tooth at the same freency as the horizontal sweep. Rather an construct another saw-tooth gene-or, the voltage is borrowed from the cilloscope. In the author's case, the ltage was obtained from one of the rizontal-amplifier grids.

GNAL PICKUP

The test leads to the coil output and , 1 plug need not make physical ntact. Since the secondary voltage quite high, a few turns of test lead re wrapped around the ignition ring offers enough capacitive coupling provide substantial signal.

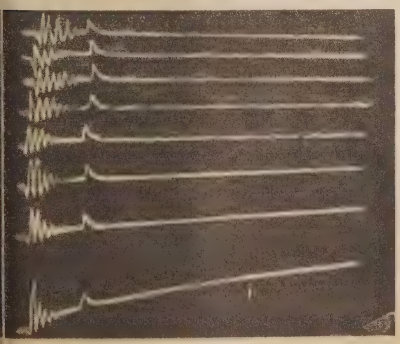
The layout of the adapter is not at critical and almost any chassis will . However, for those who may wish duplicate the author's unit, the folving construction details are given. 3" x 4" x 5" case serves as both assis and case, as shown in the photo.

(Continued on Page 123)



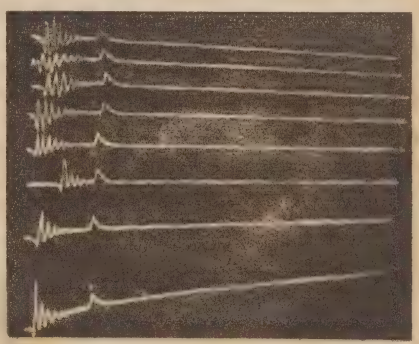
R1, R11, R14, R15—1 megohm, ½ w. res.
R2, R4—51,000 ohm, ½ w. res.
R3—1000 ohm, ½ w. res.
R5—100,000 ohm pot.
R6, R9, R10—100,000 ohm, ½ w. res.
R7—10 ohm, ½ w. res.
R8, R12—5 megohm pot.
R13, R16—1 megohm pot.
R17—21 ohm, 5 w. wirewound res.
C1—.01 ufd., 400 v. capacitor.
C2—.5 ufd., 500 v. oil-filled capacitor.
V1—12AU7 tube (12AT7 or 12AX7 can be used).
V2—2D21 tube.

Figure 7—Car battery supplies heaters, scope supplies the B-plus voltage required.



Fairly normal display from 8-cylinder car with 50,000 miles on odometer and with about 3000 miles since last engine tune-up.

Same auto as at left, but with wide spark gap (line 2) and shorted plug (on line 6). Note base-line lengths before oscillations start.



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32 mfd. 350v. 7/4
50 mfd./525v. 15/3
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Here's your answer, Tom!

Ever eager to learn, Tom, this month has another series of interesting questions. The queries range from radio reception to audio reproduction, and no doubt you will find an answer among them to a number of queries that have been bothering you. Take the first one for instance.

In the Answer Tom feature of your August issue you state that battery valves cannot be used in mains sets. Could you please explain then how 2-way portable sets work, when they are supposed to operate either from batteries or the mains at the flick of a switch?

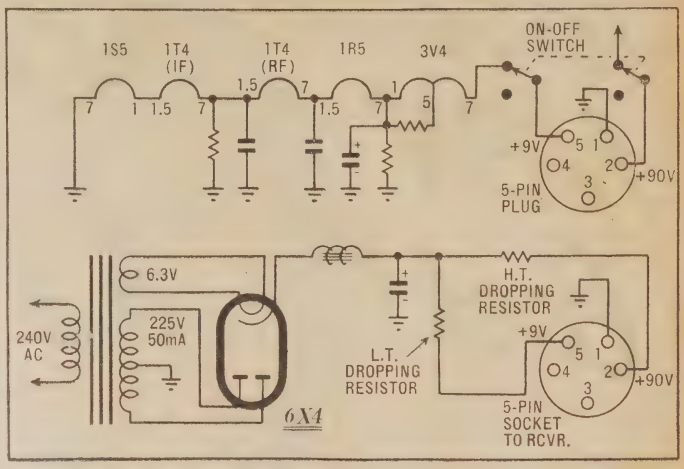
In the issue you mention, Tom, the statement regarding battery valves was that they are not suitable for direct AC operation. However, this is not the case in a two-way portable set.

Such a receiver contains a rectifier and filter system, which are switched in for mains operation. As the filaments of the valves cannot be operated directly from the mains, they are supplied from the rectified and filtered DC in the same way as the remaining receiver circuits.

In such receivers the filaments are generally connected in series and fed through a dropping resistor, since it is easier to filter a high-voltage low-current supply. The current drain of a series-connected filament network is quite low and well within the scope of a small receiver-type power transformer-rectifier combination.

A further advantage of a series-connected filament circuit is that, by suitably arranging the filaments, it is possible to apply the correct bias to the grids of the valves. This bias is derived from the voltage drop across each filament and avoids the need for a separate bias arrangement.

To get a clear idea of the foregoing, we suggest that you study the reproduced circuit.



Filament connections for AC-DC portable set.

★ ★ ★

What is the limit to the use of high quality speakers on ordinary mantel radios?

The limit to the use of high quality speakers in ordinary mantel radios is purely one of cost. Mantel sets are a highly competitive line and consequently are not made any more elaborate than is necessary for them to sell. Besides, the full benefit of a good speaker will not be realised in a mantel cabinet, due to the inadequate baffling.

However, if you wished to use a good speaker with a mantel receiver, some improvement may be effected, even with the restricted audio content of the demodulated signal. Also the sensitivity of a good quality speaker is likely to be better, on account of the larger magnet structure, so that you will need to feed less power into the speaker for a given acoustical output, resulting in cleaner reproduction.

★ ★ ★

What is a "Zepp" aerial?

A "Zepp" aerial, which is short for Zeppelin aerial, is a horizontal half-wave dipole, end-fed with tuned feeders.

A stationary pattern of voltage and current nodes and antinodes is formed along the feeder, spaced half a wavelength apart, the result of an interference pattern between wave energy travelling to the aerial from the transmitter and a second set of current and voltage waves reflected back from the aerial end.

This type of aerial is much used by amateurs for transmitting and receiving on specific frequency bands.

★ ★ ★

What are primary electrons?

Primary electrons are those electrons emited by the cathode of a valve, as distinct from the secondary electrons which are emitted from other electrodes when bombarded by electrons from the cathode.

★ ★ ★

What is harmonic distortion?

Harmonic distortion is said to occur when any device such as a pickup, amplifier or speaker adds spurious harmonic frequency components to the original signal. It is caused by a non-linearity in the mechanical or electrical operation of these devices.

For example, the stylus movement may not have an exact relationship to the output voltage of the pickup cartridge. Likewise the cone movement of a speaker may not correspond to the voltages fed to it. In an amplifier, too, non-linearity may arise from incorrect operating conditions in the valve circuits.

Ordinary everyday sounds, such as speech and music, contain fundamental and harmonic frequencies and it is the relative amplitude of the harmonics to the fundamental in these sounds which gives them their characteristic quality. Any addition to the harmonics will cause a distortion of the sound which may be apparent to the ear.

Odd harmonics, particularly those of a high order, are very objectionable, tending to produce a harsh, buzzing effect.

The same non-linear effects which cause harmonic distortion also cause intermodulation, whereby the original frequencies present tend to beat or heterodyne to produce sum and difference frequencies. Unlike harmonics, intermodulation products have no musical relationship to the fundamentals producing them.

In the presence of intermodulation, complex sounds, as from an orchestra, become highly confused, lacking good definition between instruments.

★ ★ ★

I was thinking of building a crystal set and the parts list specified four terminals. What type of terminals must I use and what are they for anyway?

Terminals, Tom, are not essential to the electrical performance of a crystal set. In other words they could be left out and the set would work as well. The same would also be true of the chassis in a crystal set. The bits and pieces could all be strung together on the

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orkshop table and provided they were onnected correctly the set would function.

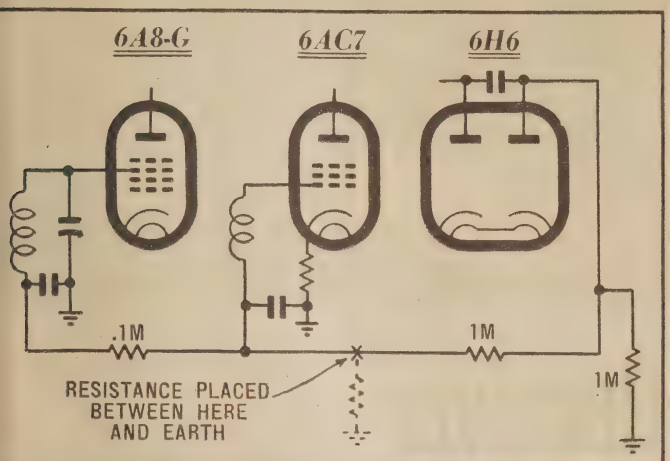
Just as the chassis is a convenient eans for holding the parts together, so re the terminals a convenient means or making connections external to the et. Without them it would be necesary to wire the aerial, earth and headhone leads directly into circuit making very awkward to disconnect them in hurry.

Many varieties of terminals have made eir appearance, their physical property eing decided by their application. Perhaps the best-known terminals for norral radio applications and in much use

latter, we suggest that you play no more records until you have the stylus checked for wear.

Grove echo is a fault inherent in the record-cutting process and nothing may be done about it. The reason is that the modulation of one groove is faintly impressed on the adjacent groove.

Excessive wear of the stylus, however, causes shoulders to be worn on the sides of the stylus tip. The shoulders will eventually ride on the walls of the groove which are also common to the adjacent grooves, thus faintly reproducing the modulation in the adiacent grooves.



"Economy Five" circuit submitted by Tom.

y experimenters are the ordinary plasc insulated spring terminals. These ay be used on either insulated or nonsulated panels and are comparatively heap.

This type of terminal is made up of central metal rod which has a hole rilled in one end while the other end threaded. The central rod is carried a plastic bushing which forms the ody of the terminals and, in use, it is ocked against the panel with washers nd a nut.

A spring-loaded sliding bush fits over he body of the terminal and, in the norhal position, rests against a flange on he end of the rod with the hole in it. o use the terminal, the spring-loaded ush is pushed back until the hole in etal rod is exposed, the wire lead is assed through this hole and the bush g released.

To make internal connection to the rminal, a solder lug is placed under he lock nut and connection made to is lug.

★ ★ ★

The other night we were listening to some records on a tablegram. During short pauses on some records the first notes of the next item could be heard softly. This persisted through a number of records in which there were pauses. Could you explain why this occurs?

The effects you have experienced may e due either to groove echo or a badly orn stylus. In case it should be the

Having completed your "Economy Five Valve" receiver, I aligned it roughly. While working on it later I happened to place a .22 meg. resistor across the points marked on the attached circuit. Instantly the sensitivity and the volume of the set increased noticeably. Replacing this resistor with a 1 meg. gave even better results. Does this place extra bias on the grids and would it harm the valves? Also would you please explain the reason for the above behaviour?

(The circuit attached by Tom is that of the AVC line in the "Economy Five" receiver. The 0.22 meg. resistor was apparently placed between the AVC line and earth from the point feeding the IF amplifier valve.)

At the outset, Tom, we must point out that the AVC system is intended to reduce the gain of the receiver, when tuned to a strong station, so that the receiver will not overload or produce excessively loud signals.

By placing the resistor in the position you mention, the effect would simply be to make the AVC circuit work less efficiently. The set would produce louder signals from the speaker, but it might also approach the condition where one or more of the early stages was approaching overload, leading to increased distortion.

Presumably, you have fallen into the

(Continued on page 119)

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The economy kit, consisting of case and one unpunched chassis suitable for simple type of Oscilloscope.

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Oscilloscope, R and H. type tube shield, 5 B.P.I

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MC7	10	8	7	17 10
MC67	12	7	6	19 9
MC81	10	10	8	1 3 6
MC811	12	11	8	1 8 3
MC82	13	8	6½	1 8 3
MC79	15	9	7	1 11 0

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SF7	7½	6½	6	15
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SF8	13	8	8½	1 6 6
SF10	18	10	10	2 1 0

R. & H. type Cabinets, finish charcoal grey, louvred sides, welded corners. Plus tax. 12½%

MC5A	9	6⅝	5½	18	9
MC82A	13	8	6⅞	1 12	3
MC87A	15	10	8	2 2	0

Sloping Front for Multimeter.

SF7A	7½	7½	7½	1 1	0

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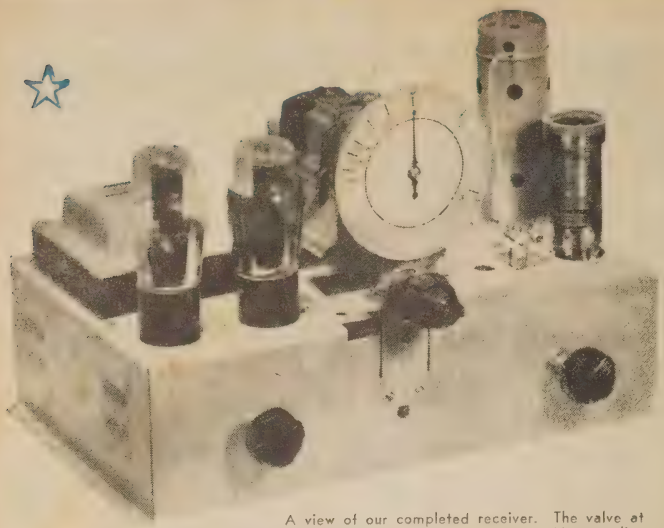


A view of our completed receiver. The valve at the extreme left is the rectifier. Next in line is the output valve, while the detector valve is in the rear right-hand corner. For the photograph the can was removed from the coil. The two lower controls are: To the left, the volume control. To the right, the reaction control.

A Simple Receiver From The Junk Box

If you happen to have the remains of an old mains-powered receiver on hand, or a collection of oddment parts that came from such a set you can most likely put them to work in a 3-valve regenerative circuit. It's a project that could appeal to anyone, from a schoolboy to an "old timer."

by Wes Yashin

AS much as anything, our decision to feature another small set like this was made to satisfy a large number of queries received in the mail, particularly from beginners.

One of their most persistent queries is for a set based on components salvaged from outdated receivers. In most cases the inquirer has just "discovered" radio or is not much past this stage. He is, very likely, a schoolboy with very limited funds and to whom a two- or three-valve junk-box receiver may be the equivalent of a multi-valve superhet to an advanced experimenter.

SIMPLEST POSSIBLE

A number of parents, too, have written in who, very wisely, want to encourage their sons in a constructive hobby. Hampered by a lack of knowledge and perhaps funds, they have appealed to us for assistance.

After some consideration, we decided on the simplest possible receiver, a regenerative one, using "vintage" type components. A minimum number of valves, too, was desirable. However, we felt that a single-valve receiver using headphones had a very limited attraction and that our receiver should, therefore, have a power output stage to drive a loudspeaker at reasonable volume.

The circuit we settled on is identical to that used for the "Basic Three" receiver featured some two years ago. The circuit is the essence of simplicity and should present no difficulties, even to the beginner. It is also non-critical with regard to layout, due to the fact that only two stages are employed and the gain is quite low. It is also extremely flexible, allowing the substitution of a variety of parts.

Referring to the circuit, you will note that the major components and stages have been individually titled for the purpose of discussion. We shall deal with each in turn and see just what components it is possible to use and how to use them.

CHASSIS BASE: Chassis size is not critical and a number of chassis could be pressed into service although, for obvious reasons, one near the optimum size would be preferable. If an old chassis is used, it should be cleaned and repainted or resprayed. Ours was a chassis handy in the junk-box, in which the original cutouts happened to correspond to the type of layout that would be suitable for a receiver of the kind we had in mind.

It was duly cleaned and sprayed with a hand spray-gun.

POWER SUPPLY

POWER TRANSFORMER: First major component is the power transformer, marked as such on the circuit. This item is a most likely one to be salvaged from an old receiver and will be a substantial unit for a couple of reasons. One is that old-time receivers required a fairly heavy current supply and the transformer was rarely rated at less than 60 mA, which is more than adequate for our present purpose.

Another reason is that they had to supply the power required to energise the magnetic field of the electrodynamic speaker, with which those sets were invariably equipped. To this end, the HT secondary winding was generally wound to supply about 385 volts, of which about 100 volts were absorbed in the field coil.

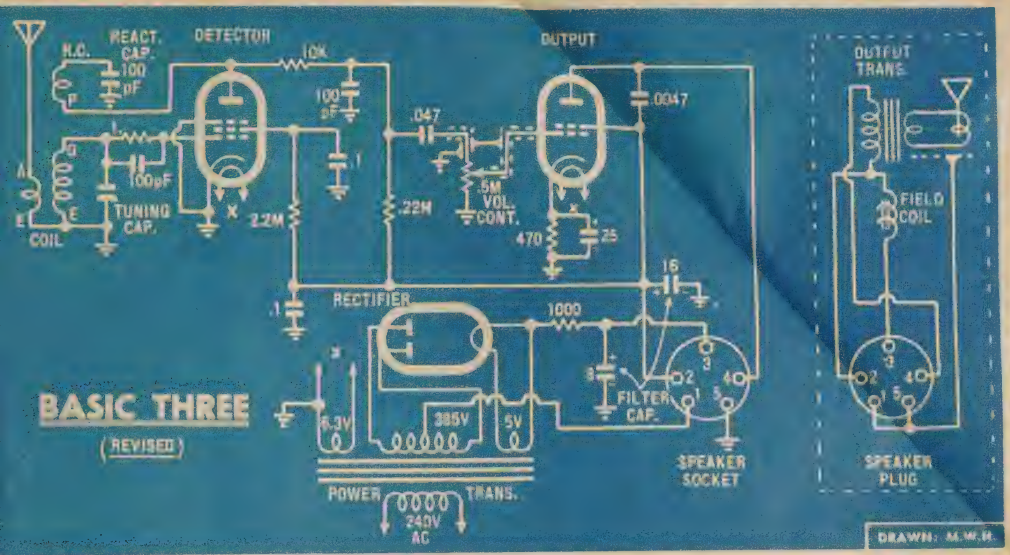
Besides the HT winding there were the primary and low tension secondary windings. The primary winding will most likely have several voltage taps, enabling the receiver to be used from 220, 240 and 260 volt supplies. The LT winding are there to supply the filaments and heaters of the valves. A 5-volt winding will be available for the rectifier and a 2.5 or 6.3 volt one for the remaining valves, depending on the types employed.

Generally speaking, the power transformer retrieved from an old set will either be good or bad.

CHECK FOR CONDITION

A close inspection will reveal whether it will be in working order. Dust the transformer and the chassis in the near vicinity. If the transformer does not smell and the insulation isn't charred it is most likely in working order. However, if the transformer smells or a winding has a charred appearance or the transformer and surrounding chassis show signs of a dark, "gooey" matter which has been expelled from its insides

CIRCUIT IS EASY AND SIMPLE TO UNDERSTAND



The circuit is a straightforward regenerative type. A single detector stage feeds into a power output stage, while a standard transformer rectifier combination supplies the necessary HT. Valve type numbers and socket connection are not shown, because a large number of suitable types are listed in the text and will require a variety of socket connections.

en the transformer is most likely use-ss.

The above signs indicate that at one me or another the transformer has been bjected to an overload or that an in-rnal short has developed.

Let us assume, though, that the trans-rmer is in working order.

The connections to an old-time power ansformer were usually made by means a terminal board, which was usually arked with the appropriate ratings. A t of cleaning with methylated spirits ill reveal the figures if they have be-ome obscured with dust and grime.

RACE WIRING

If the figures are absent or the trans-rmer termination is with leads instead a terminal board, try and trace the iring prior to removal from the original hassis. A description of the connection the transformer into circuit which ill follow should assist you in the acing of these leads.

As mentioned previously, the trans-rmer will have a primary winding hich is to be connected to the mains. his winding may be identified by the gures on the terminal board, represent-g the input voltage taps. It is unlikely at any but the 240-volt tap will be equired but, should your supply voltage e other than 240 olts, the appropriate p must be used. The second point of onnection is the terminal marked C, be-g the "common" end of the winding. Use a 3-core cable for the incoming C lead, connecting the third "earth" ire to the appropriately marked lug on e transformer, which, in turn, should e connected to an earth point on the etal chassis, via some tinned copper ire.

The secondary windings on a power transformer consist of a high-voltage winding (in our case, of about 385 volts) and two or more low-voltage windings for the filament supplies.

The extreme ends of the high-voltage winding are connected to the rectifier plates, while the centre tap is earthed. Note, however, that it is not earthed directly but through the five-pin speaker socket and plug. The reason for this will be explained in a later paragraph.

RECTIFIER: The rectifier valve should logically be installed in the immediate vicinity of the power transformer. In our case, it is in the top left-hand corner of the chassis in the under-chassis view.

Several types of rectifier may be used in this set but the most likely ones are of the directly heated type, such as the 80 and its octal equivalent, the 5Y3. The 5Z3 or octal-based 5U4-G are also possibilities, likewise the 83V and 5V4-G. These last two tend to give higher output voltage than the others and it may be desirable, if you use either one of them, to increase the 1,000-ohm resistor to about 1,200 ohms.

RECTIFIERS

The 80 valve, the 5Z3 and the 83V all have 4-pin bases and the filament connects to the two thick pins, numbered 1 and 4. The thinner pins, numbered 2 and 3, connect to the plates. Neither the filament nor the plates need to be connected to the respective windings a particular way round.

For the octal-based rectifiers, types 5Y3, 5U4 and 5V4, the filament connects to pins 2 and 8, while the plates connect to pins 4 and 5.

The rectifiers just listed are the ones

PARTS LIST

1 Chassis approx. 12 x 8 x 2½ inches.
1 Power transformer.
1 Electrodynamic speaker with transformer to suit output valve.
1 Coil.
1 Tuning capicitor and dial.
3 Valves and sockets to suit.
For more specific information on the above components refer to the text.

CAPICITORS.

1 100 pf reaction capacitor.
1 16 mfd 600 volt electrolytic.
1 16 or 8 mfd 600 volt electrolytic.
1 25 mfd 40 volt electrolytic.
2 .1 mfd 600 volt paper.
1 .047 mfd 600 volt paper.
1 .0047 mfd 600 volt paper.
2 100 pf mica or ceramic.

RESISTORS.

1 2.2 meg, ½ watt.
1 1meg, ½ watt.
1 .22 meg, ½ watt.
1 .01 meg ½ watt.
1 .5 meg potentiometer.
1 1,000 ohm, 5 watt.
1 470 ohm, 3 watt.

SUNDRIES: Hookup wire, shielded wire tinned copper wire, enamel wire for coil, 1 4-lug mounting strip, 2 3-lug mounting strips, nuts and bolts, solder lugs, solder, mains flex and plug, rubber grommets valve and coil shields to suit, 3 knobs, 2 spring terminals.

★ CRYSTAL MICROPHONES
★ MICROPHONE INSERTS

TABLE or STAND MICROPHONE MIC22

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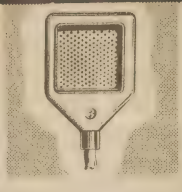

LAPEL MICROPHONE MIC28

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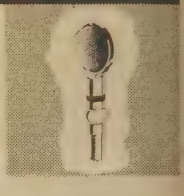

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DESK or HAND MICROPHONE, MIC36

Ideal for home recording public address, etc. The performance is not affected by vibration, shock or low frequency wind noise. Omni-directional frequency response substantially flat from 30 to 7,000 c.ps. Recommended load resistance not less than megohm, dependent on low frequency response. Can be supplied complete with switch and floor stand adaptor, as required, at a small extra cost

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ost likely to be considered for an old-yle receiver. All are intended to oper-e from a separate 5-volt filament wind-g, with the B-plus taken from one fila-ent pin.

If you should happen to have on hand ne of the more modern miniature rec-fiers, such as the 6X4, 6X5-GT and V4, they could be used, provided the ansformer has a 6.3 volt filament wind-g. This can supply one of the above-entioned rectifiers, as well as the other alves, the B-plus being taken, in this ase, from the rectifier's separate cathode n.

The rectifier socket, if salvaged from n old set, will most likely be a wafer pe and must be thoroughly cleaned. there are any signs of breakdown or harring between the pins, the socket hould be discarded. Cleanliness is im-ortant for the rectifier socket, because is subject to a considerable voltage nd, together with speaker socket, would e the first to break down if the insula-on is impaired by charring or excessive rt and flux.

CONTACTS

Bend or tighten the contacts, if neces-ary, depending on the type of socket, o as to increase their grip on the valve ins.

Connection between the 5-volt winding nd rectifier filament is made by means f some twisted hookup wire. Since the igh tension is taken from the heater, aking the heater winding at the HT otential above earth, this winding must emain insulated from earth and other ircuits.

The plates of the rectifier are con-ected to the high tension secondary inding in the same manner as the eaters. The centre tap of this wind-ng goes to earth via the five-pin plug nd socket which, being the next in the iring sequence, will now be discussed.

SPEAKER SOCKET: Since the high-ension filter circuit involves the loud-peaker field coil, the 5-pin socket and lug arrangement is necessary to provide ontact between the speaker and chassis.

High Tension is taken from one of the ectifier filament pins and a lead is run o a tag strip which supports the HT ropping and limiting resistor shown as ,000 ohms in our circuit. (It is actually nade up of 2 500-ohm resistors in series n the original set.)

The value of this resistor may need o be altered, depending on the value f the field coil. The 1,000-ohm value vas selected for a 2,500-ohm field coil ut a variation in field resistance of 500 hms or so, should not make any great difference.

FIELD COILS

With field coils of 1,500 or 1,000 ohms, he resistor should be increased to about ,000 ohms. In all cases the high tension must remain in the vicinity of 250 volts, his measurement being taken with the 5-pin speaker plug in its socket and the power supply properly loaded by the re-maining valve circuits.

FILTER CAPACITORS: A filter capa-citor is connected to the end of the resistor opposite the rectifier filament. An 8 or 16 mfd unit is suitable and must have a voltage rating of at least 500.

At this stage, a word of warning may not be out of place. Do not in any circumstances use electrolytics salvaged from an old receiver. Their capacitance will be low and their leakage may have deteriorated sufficiently to endanger the rectifier and perhaps the power transformer. A pair of new capacitors is almost essential.

From the point of connection of the first filter capacitor a lead also goes to contact 3 of the 5-pin socket. This is to make connection to the field coil, which is series with the HT line (between contacts 2 and 3), the corresponding pins of the plug making the actual connection.

CONNECTIONS

Contact 2 of the 5-pin socket is the high-tension point and a lead connects it to the second filter capacitor, which is similar to the first but may have any capacitance value from 16 mfd upwards. From this point also a .1 mfd bypass is run to earth.

Contacts 1 and 5 of the 5-pin speaker socket are simply there to make or break the connection between centre tap and earth as the speaker plug is inserted or withdrawn. This is a safety precaution so that no HT will be applied to the valves while the speaker is not connected.

The speaker transformer is connected between contacts 2 and 4, the actual connection being made by the corresponding pins of the speaker plug.

LOUDSPEAKER: The electrodynamic speaker and the output transformer form an integral unit separate from the main chassis. This unit may have been salvaged and kept in reasonable order or, on the other hand, it may have been exposed to the ravages of time, dirt, mice, etc.

Before the speaker is used it must be thoroughly checked and cleaned. A small paint brush or a bicycle pump will prove invaluable during the cleaning operation, to dislodge pieces of grit.

The next step is to patch up the speaker. Tears in the cone may be repaired with the aid of a resilient cement, such as "Bostik." A fouling voice coil may often be recentred by loosening the centre screw and inserting small strips of light card in the gap between voice coil and pole pieces. The screw is tightened, and the strips are withdrawn. The voice coil should now be quite free in the gap and gentle pumping of the cone will establish this point.

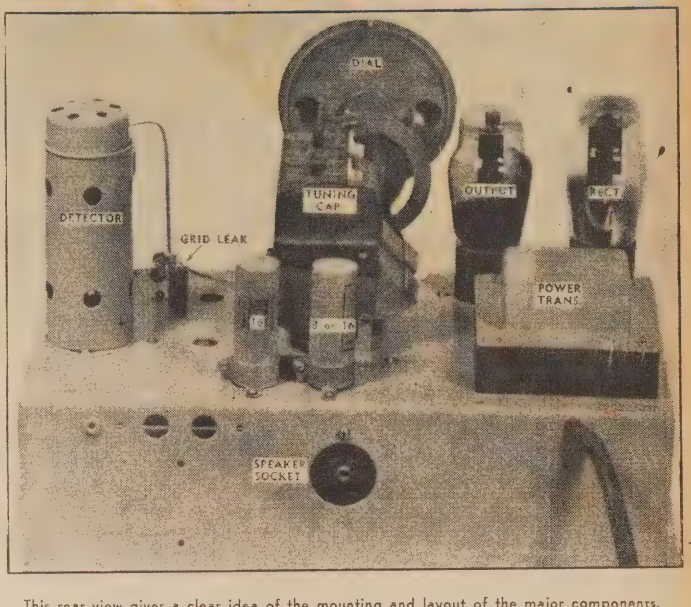
Finally the connecting cable should be renewed if the original shows signs of deterioration. Three of the leads in this cable are carrying the HT supply and too much stress cannot be laid on the danger of wiring becoming exposed.

SPEAKER PLUG

The speaker you have on hand may have a plug attached already but, even if it happens to be a 5-pin type, there is no guarantee that it will be wired according to our diagram. It may have to be reconnected to correspond or even replaced altogether, if it happens to be a 4-pin type.

OUTPUT VALVE: Next in our logical progression is the output valve. This could be one of a number of types, but the most likely ones to find their way into the junk box are the 59, 2A5, 42.

A BACK VIEW OF THE CHASSIS



This rear view gives a clear idea of the mounting and layout of the major components. We used can type electrolytics mainly because these happen to be on hand, but pigtail types mounted under the chassis would do as well. The only above the chassis wiring consists of the 1 meg grid leak and the 100 pf capacitor, mounted on a three-lug strip, with the appropriate leads to and from this.

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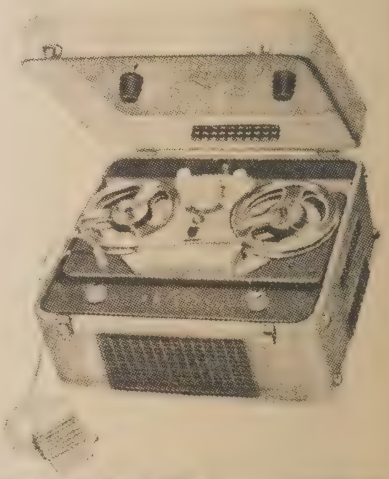

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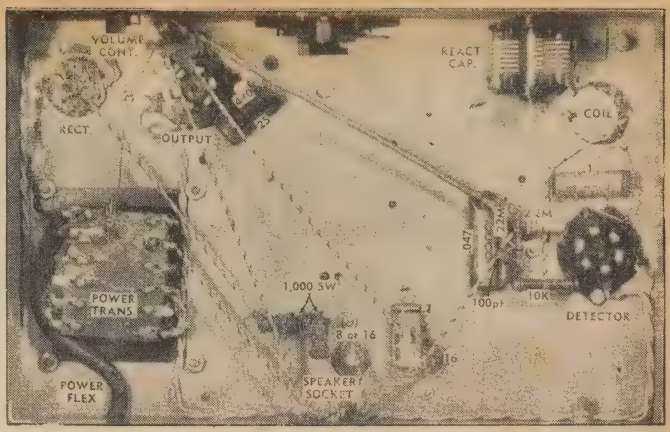
6 and 6K6 variety. The values given the circuit are quite suitable for these es and require no changes.
The 59 type when connected as a pen-de (grid 3 tied to the cathode) is elec-cally equivalent to the 2A5, when erated from a 250 volt HT supply th these valves are of the 2.5 volt e, the 59 having a 7-pin base while 2A5 has a 6-pin base.
Similar valves with 6.3 volt heaters e the 6-pin type 42 and the octal-based e 6F6. The 6K6 is another octal-sed valve having similar character-ics and suitable for our set. As men-ned previously, all the above types n use a bias resistor of about 470 ms and a plate load (the output nsformer primary impedance) of 00 ohms.

UTPUT VALVES

In the European series, valve types 3NG, EL33, EL33A and EL33B have tal bases and 6.3 volt heaters. Their ate load requirements remain the same t their bias resistors will have to be ered to about 150 ohms.
Due to their sensitivity these valves e sometimes prone to parasitic oscila-n and may require a grid stopper. hich is a resistor ranging in value from out 10K ohms to about .047 meg. is grid stopper is inserted in series th the lead running from the potentio-eter to the grid, and as close to the id pin as practicable.
The 6V6 is another excellent output lve to use in this circuit and, if one available, the bias resistor will have to altered to about 270 ohms.
Whatever the valve type used, it is st positioned on the chassis between e detector and power supply. The cket should be so oriented that the nnection between grid contact and the oving arm of the potentiometer is ort. The remaining connections are t critical but will involve you check-g up on pin connections in a valve data ok or chart.
A twisted pair of leads will join the aters to the appropriate winding on e transformer. One side of this wind-g should be earthed and, this may be ne af the transformer or at one of e valve pins.

ATHODE CIRCUIT

The cathode resistor and its bypass e swung between the cathode contact d a solder lug under the socket retain-g nut. The plate bypass capacitor ounts likewise between the plate and reen contacts. A lead joins the screen ntact to the HT point, while the plate ntact is connected to contact four of e speaker socket.
The volume control in the grid cir-it of the output valve is a standard otentiometer and is not critical in lue. Any unit with resistances rang-g from .25 meg to 1 meg will be suit-le.
Many beginners have difficulty in con-ecting a volume control the right way und. Looking at the rear end of the otentiometer with the lugs upward, the ft end one goes to earth, the centre ne is the moving arm and goes to the id of the output valve, while the right id one goes to the coupling capacitor
DETECTOR: Next we come to the etector stage. This is a straightforward generative circuit, in which reaction controlled in the plate circuit of the lve by means of a suitable capacitor.



The simplicity of the wiring is evident in this under-chassis vew. The placement of the major components may vary with different chassis, but the general trend in the layout of the minor components would remain the same.

A large number of valve types can be used in this position. Among the better known types are the 24A, 78, 58, 6S6, EF39 6U7, 77, 6K7, 6SK7, 6S7, 6J7, 6SJ7. The valves need not be new, for as long as they are pronounced "Fair" on a valve check, they will most likely regenerate.

As with the output valve, it must be a type requiring the same heater voltage as is available on the transformer, and you will have to provide the right type of socket and the appropriate connections to it.

In the underchassis view you will observe that the various minor components are grouped around the valve socket and suspended with the aid of a tag strip. The coupling capacitor is clearly visible on the left of the tag strip. A shielded lead from one end of this capacitor is run to the right end lug on the volume control. Do not forget to earth the braiding on this lead.

The heater supply to this valve is run in a similar manner to that of the output stage, by means of a pair of twisted leads. As one side of the heater winding should already have been earthed, do not do so again for a short may result.

We have now reached the tuned circuit. For the purpose of discussion we shall break this up into three sections: (1) the coil, (2) the reaction capacitor and (3) the tuning capacitor with the dial.

COIL: The coil may be a standard Reinartz bought over the counter, or, it may be an aerial coil salvaged from a receiver, to which a reaction winding has been added.

AERIAL COIL

We shall assume that the latter is the case and that it is possible to salvage an aerial coil. Check the coil thoroughly to ensure that there are no shorted turns or other damage which will impair or prevent its functioning.

Most of the old receivers used bakelite or cardboard coil formers of about 1¼-inch diameter, wound with silk or enamel covered wire. The windings and their terminals should be free of corosion and there should be no dry joints where the windings terminate.

The coil will consist of two windings. The smaller of the two windings, about 15 or 20 turns, is the aerial or primary winding. The lower end of this is usually connected to earth while the upper end is connected to the aerial terminal of the set.

Spaced about 1/8-inch away is the tuned winding of the coil or its secondary. This winding normally has 100 or so turns. The lower end of this is also earthed while the upper end goes to the grid of the first valve and the stator of the tuning capacitor.

EXTRA WINDING

The auxiliary winding will have to be accommodated on top of the coil former about 1/8-inch from the tuned winding. Two extra lugs will be required at the bottom of the former or, one lug if the two earthy ends of the windings are terminated at a common lug. Our winding consisted of 40 turns of 34 B and S enamel covered wire. The gauge is not very critical but a fine wire is necessary to ensure that the winding does not take up too much space.

The winding is wound in the same

(Continued on Page 127)

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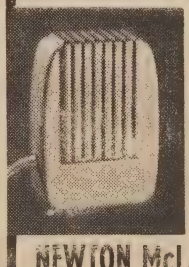
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FROM THE SERVICEMAN WHO TELLS

While home builders of radio sets appear to have less trouble with their projects than one might expect, it is only natural that they should encounter troubles now and again. This month's story concerns just such a case, and is interesting on a couple of counts.

The set was the R. TV. and H. Standard Radiogram which was described in May last year, and the builder is a business acquaintance who may be best described as a typical radio enthusiast. He has no interest in radio other than as a hobby, but he follows it with surprising enthusiasm.

The latest amplifier, control unit, or tuner design will capture his attention, and it is only a matter of days before it is under construction. Normally he is quite successful, and the new unit will occupy pride of place for a short while, only to be stripped down or donated to a friend in favour of something more ambitious when the novelty has worn off and he has become critical once again. Truly, a typical enthusiast.

PREVIOUS HELP

On one or two previous occasions, when he has been in doubt about some point, I have been able to help out with a few words of advice, this normally being all that was needed to solve the problem. However, when he brought me his troubles this time I realised that it was not going to be as easy as in the past. His complaint was very low power output or, alternatively, very severe distortion if any attempt was made to deliver reasonable power.

I asked him a few fairly obvious questions, established that it really was lack of power and not lack of sensitivity (you'd be surprised at the number of fellows who can't tell the difference) and then, after a little more discussion, it became obvious that we would not get very far without the set itself.

At my suggestion, therefore, he stopped by my shop the following day and sat the offending chassis on the bench.

"There's the monster," he said. "I hope you can do something with it. I've fiddled with it until I'm sick of it. There's no hurry; whenever you have some slack time will do." And, without waiting for further discussion he was off; leaving me with his "monster."

It was, in fact, a couple of days before I was able to look at the set properly. When I did, the soldering caught my eye.

COMMON FAULT

Our friend had developed a technique which is something of a classic among beginners; a technique which I can only describe as "pasting." It is particularly evident where the items to be joined can be held together in some fashion without the aid of solder, as when a wire is hooked through a lug, or when two wires are twisted together.

Having joined the two pieces in this fashion, the operator then proceeds to "paste" the joint with solder, much as one would apply paste or glue. Provided the joint is surrounded with solder in some form, he consider the job finished, regardless of its appearance — and appearance is all important in a soldered joint.

More careful examination in this case confirmed that two or three of the joints were really "dry," while several more were extremely doubtful. I spent some time going over these, remaking them and double checking the remainder to be quite sure. While thus engaged it occurred to me that a brief discussion on the subject may not be out of place; especially as habits of this kind, acquired while learning, are often hard to eradicate.

In order to get a really clear picture of the problem it might be best if we go right back to basic principles and consider just why the process of soldering works at all. That done we should be in a better position to appreciate the problems of making a good joint.

All metals may be regarded as porous to some degree, even though this condition is not immediately obvious to the unaided eye. Solder is able to adhere to the metal simply because it (normally) penetrates these pores in a liquid state, and then hardens. Making sure that this penetration occurs is the fundamental requirement to ensure a successful joint.

There are two main factors which tend to prevent this happening; the presence of foreign matter, usually an oxide of the metal, and insufficient heat.

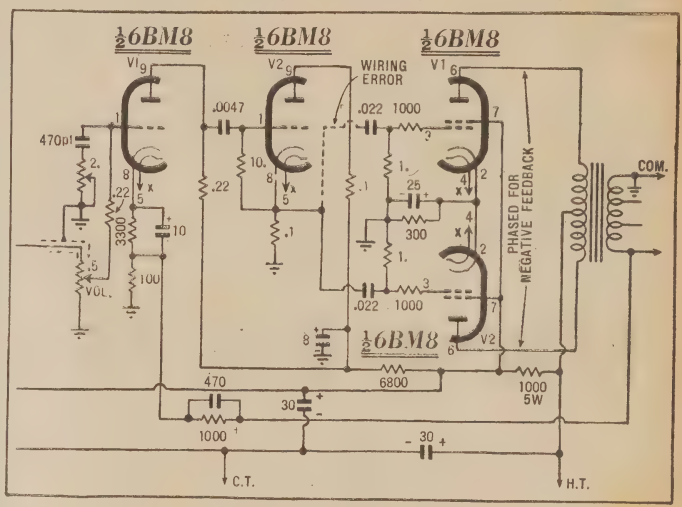
It is to combat the foreign matter that we use a flux of some kind. Regardless of how carefully we clean the surface, the metal will commence to oxidise again immediately. While the process is not rapid enough to worry us in the ordinary way, it becomes extremely rapid as soon as the metal is heated to make the joint. The primary job of the flux is to cover the surface and exclude the air during this heating process.

The simplest fluxes—such as resin—do just this and very little more. They are deliberately chosen for their non-corrosive qualities where fine wires and delicate equipment make this feature essential.

But this very advantage is also a disadvantage. Because they are so inert they cannot be expected to exert any cleaning action of their own, and any foreign matter present before they are applied will still hamper the soldering process. Careful cleaning by mechanical abrasion is therefore essential where these fluxes are to be used.

Going to the other extreme we have some highly corrosive fluxes such as those used by plumbers and tinsmiths. Pure hydrochloric acid ("neat spirits" or "spirits of salts") is customarily used on zinc and galvanised materials, and "killed spirits" (mainly zinc chloride formed by dissolving zinc in hydrochloric acid) for most other metals.

Their action is pretty violent, particularly in the case of the neat spirits, and enough to give any conscientious radio man a touch of the blind horrors. (I can still remember some beginners' sets I encountered in years gone by, on which such fluxes had been used. They



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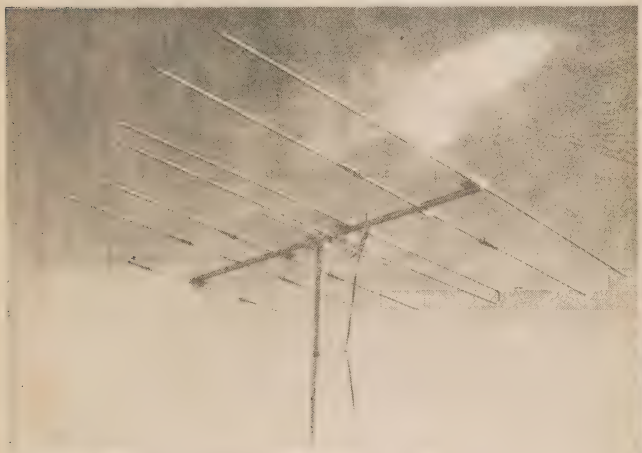

LONG LIFE IN SEA COAST—INDUSTRIAL AREAS:

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DESCRIPTION:

At first glance these new designs have the flat in line appearance of 6 and 7 element low-band yagis but in actual fact there are 14 and 15 individual elements respectively employed. Using the famous "Channel Master" Rainbow "triple-power" principle of hi-band directors and reflectors the Colinear is designed to peak at Australian Channels 2, 7 and 9. The 3-segment hi-band directors and reflectors with each segment insulated from its adjacent segment provide the combined power of 3 hi-band yagis.

APPLICATIONS:

For those difficult areas relatively close to the transmitter but where 7 and 9 are weak and/or ghosting. In such locations Channel 2 is often very strong and low-band gain is deliberately reduced by eliminating the low-band reflector. Performance on 7 and 9 is not affected by this procedure. The Colinear 14 should be installed in such cases. For fringe area installation the Colinear 15 has excellent gain particularly when stacked.

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were not a pretty sight after a few days.) However, for the job they are intended to do, they are perfectly satisfactory; if only because the plumber can usually slosh a bucket of water over the job when it is finished to wash away the surplus.

What is most important, however, is the fact that they clean the job as well as provide a flux. The action is somewhat drastic, it is true, but highly effective, and even a well weathered piece of roof iron—provided it is not actually rusty—will respond to such a flux without any preliminary cleaning.

It is fairly obvious that there must be a need for a number of fluxes intermediate between these two extremes and having degrees of cleaning ability—and permissible corrosion—dictated by the nature of the job.

The popular paste fluxes are one example of these. While their exact contents is something of a mystery, I understand that it consists of a small quantity of "killed spirits" in a base of petroleum jelly, plus some colouring matter in most cases.

COMPROMISE

These pastes have a good cleaning action as a general rule, yet are not so corrosive as to be dangerous if used with care. While no one would consider them for soldering fine coil wires, they are usually safe enough for chassis joints, or ordinary hookup wire and solder lug work on the rare occasions that it may be necessary. It is usually considered good practice to wipe the surplus away with methylated spirit where this is possible.

More recently there have been developed the so-called "activated" fluxes; fluxes designed for use in cored solders and consisting basically of resin, but with certain chemicals added in carefully controlled proportions to provide some cleaning action.

Judging by the general acceptance of these by the various armed services and other organisations, in most cases following exhaustive tests, it would seem that the chemists responsible have struck a nice balance between the conflicting requirements.

In practice these fluxes work very well, much better than the older pure resin-cored solder. Assuming reasonably clean tinned lugs or wires as normally encountered, soldering is quick, easy and positive, provided the correct technique is used.

ENOUGH HEAT

Which brings us to the second point: the need for sufficient heat on the job. A few moments' thought will make it abundantly clear just how useless it is to apply a blob of molten solder to a piece of cold metal and expect the one to penetrate the pores of the other.

What actually happens, of course, is that the solder, once it hits the cold metal, ceases to be molten or liquid and becomes solid; at least, where it is actually in contact with the metal. In other words, the solder is no longer able to "wet" the metal and produce the intimate contact required. It will also be appreciated that the term "dry joint" is a far more accurate one than might at first be imagined.

From which we may deduce a fundamental law of soldering: It is essential that the pieces of metal to be joined must be raised in temperature to the point where they can, if necessary, be used to melt the solder. It is only when they are so heated that the solder can remain molten while in contact with them, and it is only molten solder which can "wet" the metal and penetrate the pores as required.

On this basis the practice of using the bit to melt the solder may be condemned as basically wrong. The purpose of the bit is to heat the metal pieces to be joined, these then being used to melt the solder. When this practice is followed it is obvious that solder cannot be applied until the correct temperature is achieved and a "dry" or "cold" joint is virtually

—TV TIMES

impossible.

From the radioman's point of view, there are two main objections to this idea. One is that it takes longer, and the other, which is really an extension of the first, is that a joint which takes a long time to make can easily endanger any delicate heat-sensitive components associated with it.

Because of the shape, size or placement of many joints, it is frequently difficult to apply the bit to them in an efficient manner. As a result, the heat transfer is poor and by the time the required temperature has been reached, considerable heat has been transferred to the components.

A further objection, when cored solder is being used, is that the joint is being heated without the benefit of protective flux. Thus, the flux, when it is applied, has to remove any oxide formed in the heating process.

MODIFIED TECHNIQUE

For this reason most of us have adopted a technique which transgresses these laws, but which is still perfectly satisfactory if the proper skill is acquired. It has been found that if a small amount of solder is applied to the bit at the same time as the latter is applied to the joint, not only will some flux be released, but the solder will wrap itself round the joint — even if it cannot "wet" it properly at this juncture —making the heat transfer many times more efficient.

In a few seconds the temperature of the joint will rise to that of the solder, and the latter will suddenly "flow" or "run" over the metal. More solder may now be fed to the joint if necessary and the bit removed smartly as soon as there is sufficient for the job.

When this technique is used it is the ability to recognise the above-mentioned "flow" or "run" which is of vital importance, and this cannot be too strongly emphasised. In fact, since most of us work in this way, it is perfectly true to say that our ability to solder stands or falls on this point alone.

If we have not learnt to recognise this condition — or do not appreciate what we have to look for—we will either fail to hold the bit on the job long enough, or leave it on too long. In the former case the solder will simply congeal around the joint and be held in place by reason of its shape, without any real ability to hold the joint together. In the latter case there is a very real danger of damaging a component.

APPEARANCE

A properly made joint is unmistakable to the experienced eye. Its surface is smooth — almost shiny — and flows smoothly down to meet the metal surface; not tucked under like a drop of water on a greasy plate. A rough, erratic surface, like a miniature lunar landscape, generally indicates insufficient heat, as does also a spike left when the bit is pulled away. A finer or more even roughness on the surface frequently means that the two parts of the joint have moved as the solder was setting.

Assuming the required skill, the technique of applying the bit and the solder simultaneously to the job works out quite well in those cases where both parts of the joint are held in place firmly without the operator's aid. However, when one half of the joint has to be held in place by the operator we need a third hand to follow this method.

The best approach appears to be that of applying solder to each part in turn, making quite sure that it "takes" correctly. Then bring both parts together and apply the bit again, preferably loaded with a small blob of solder to add to that already present. In this way the need to apply flux during the second operation is avoided, yet there is little risk of a faulty joint.

BAD PRACTICE

Except in a case such as that just mentioned, it is not good practice to convey cored solder to the job as a molten blob on the end of a bit. The reason is a very good one: by the time the solder reaches the job, the flux which is contained will have been burnt away.

And just one final thought on the subject of soldering. It used to be the proud boast of the skilled soldering operator that his was a job which could never be replaced by the machine; no matter how they tried, the professors would never be able to duplicate mechanically the highly skilled process of making a soldered joint.

Alas for their complacency. Modern printed wiring techniques have made this a practical reality today, and, what is more, those who use it claim that the machine delivers a much lower percentage of dry joints than human operators, skill and all notwithstanding.

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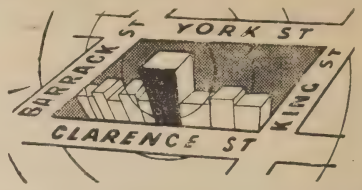

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I imagine this could be due to the fact that the machine is not day-dreaming half the time about the boy friend or the girl friend, the latest rock 'n' roll number, or how long it is to knock-off time.

All of which seems to have taken us a long way from the Standard Radiogram I set out to discuss, but I feel that the digression will have been justified if I have clarified any doubtful points about an "art" which is so often clouded in mystery.

Reverting to the set proper, I finished checking the soldered joints and turned my attention to the supposed lack of power output. Tuned to a local station, the set performed well enough in most respects, but it was clear that there really was something wrong in the output stage.

At low volume it didn't sound too bad, although even this seemed to have an "edge" on it rather out of keeping with a set of this kind. However, any attempt to produce real volume resulted in hopeless distortion. Far from producing anything like six or seven watts, I judged its limit to be nearer a couple of hundred milliwatts.

SAME STORY

I substituted a signal generator for the station and listened to the 400-cycle note, which told much the same story. However, I did notice one peculiar effect. Having occasion to switch the set off for something, I was struck by its performance when I switched it on again. As the valves warmed up it gave a momentary indication of normal operation, the 400-cycle note swelling to full-blooded proportions for a second or so, then choking and dying to its previous weak and distorted condition.

A check with the multimeter revealed nothing. All voltages were near enough to correct, suggesting that, statically at any rate, the output valves were working near enough to normal.

I decided it was time to bring the CRO into operation, both to confirm my observations and to try to isolate the offending stage. It quickly verified what I had heard, including the brief high output during the warm-up period. If anything, the waveforms were worse than I had realised.

Before attempting to check any of the earlier stages I located the negative feedback network and put it out of action. This is an essential precaution when trying to locate a source of distortion in this manner, yet it is surprising the number of fellows who fail to observe it. As a result they find themselves — almost literally — running round in circles.

IMPORTANT POINT

However, the point should not be hard to appreciate. Assuming the presence of a distorting condition somewhere in the middle of the feedback loop, it is quite obvious that all signals beyond this point will contain this distortion, including the negative feedback line.

Now, since the feedback line is connected into the front end of the amplifier, this distortion will also appear ahead of the stage actually creating it. (Admittedly, the distortion will experience a phase change as it passes through the distorting stage, but it is seldom that this is immediately apparent). In these circumstances it become virtually impossible to pick the point of origin, since the distortion appears to be all through the amplifier.

In this case, with feedback disconnected, the signal was perfectly clean from the volume control right through to the grids of each output valve, even with the volume turned well up and handling a solid signal. The trouble was clearly in the output stage somewhere.

Both output valves immediately came under suspicion, but a couple of new ones I had on hand behaved in exactly the same manner, thereby removing any doubt on that point.

Could it be a faulty output transformer? Previous experience with shorted turns in one of these devices had taught me never to take them entirely for granted. I quickly rustled up another one having similar characteristics and strung it temporarily into circuit. Once again I drew a blank.

Next I checked the grid circuits of each output valve, considering the possibility of leakage through a coupling capacitor or of a grid resistor having "gone high," with resultant grid current complications.

Both investigations proved negative, but I did discover something else. Removing either valve from its socket gave the surprising effect of increasing the output appreciably and removing most of the distortion. This was the direct opposite of what one would normally expect, and I began to realise that this was no ordinary fault.

I did a spot of head-scratching and checked over the symptoms. Bad distortion with very limited output; brief improvement during warm-up; best results with one valve removed. No leaky coupling capacitors, faulty grid resistors or valves. And clean signals right up to the output valves. Somehow it didn't make sense.

Then it occurred to me that I hadn't really checked the wiring in detail. True, I had checked the soldered joints and made a quick voltage check, but I hadn't been over the set, point by point. Maybe it was time I did.

Since the output stage appeared to be the offender, I commenced checking the connections to the pentode sections of the 6BM8s. It didn't take me long to find the culprit, and when I did the reason for all the funny effects became clear.

The builder had strung all the minor components associated with these two valves between a couple of tag strips mounted parallel with each other; much as was specified in the original design, but with some minor variations.

This was all right as far as it went, but, by simply shifting one capacitor pigtail one terminal out of sequence, he had effectively connected both output grids to the same side of the phase splitter: the cathode side as it happened

CONFLICT

Thus, the two output valves were being fed with in-phase signals, yet were expected to deliver out-of-phase signals to the push-pull output transformer. Theoretically, they should have delivered no output at all, the two equal and opposite signals exactly cancelling.

However, since it would be unrealistic to expect that such signals would be exactly balanced in all respects, there would be some output representing the small degree of unbalance. This was the only signal the set had been delivering up until this time; small wonder it was weak.

It also explained why the performance improved so markedly when one valve was removed. With the bucking signal removed, the remaining valve was able to function as a reasonably efficient single-ended stage, capable of delivering several watts.

Similarly, during the warm-up period, one valve apparently commenced working a short while before the other, thus enjoying a short period of operation

(Continued on Page 123)

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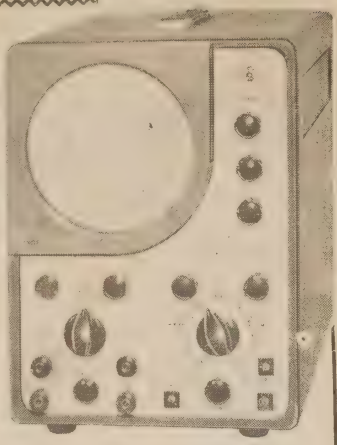

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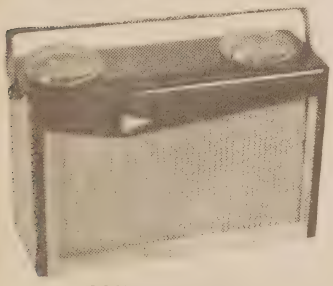

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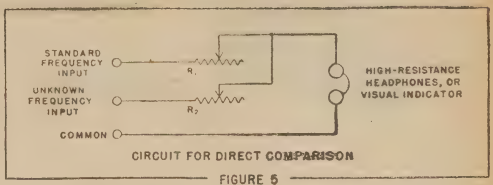
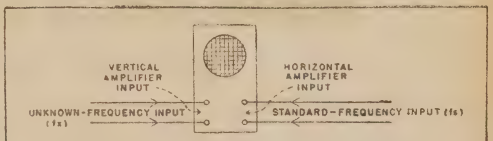
AUDIO FREQUENCY STANDARDS

Part one of this article, which appeared last month, surveyed various types of frequency standard. This concluding section describes methods by which an unknown frequency may be compared with a signal from a standard frequency source.



CIRCUIT FOR DIRECT COMPARISON

FIGURE 5



USE OF OSCILLOSCOPE FOR LISSAJOUS PATTERNS

FIGURE 6

☆

PART TWO

☆

AUDIO frequency measurement involves the comparison of the unknown frequency with an accurately known frequency derived from a standard instrument such as described in the foregoing paragraphs.

Or the frequency may be determined with an instrument which previously has been calibrated against some audio frequency standard. The several common methods of measurement are discussed below.

Two audio frequencies may be compared directly by either visual or aural means. The zero-beat method is employed.

In the aural scheme, headphones are used to detect zero beat by ear. In the visual method, the zero beat indicator may be either an AC vtvm, magic-eye indicator, or oscilloscope.

Figure 5 shows a simple circuit for direct frequency comparison. Best results are obtained when the voltage amplitudes of both the standard and unknown signals are equal. Rheostats R1 and R2 are provided for individual adjustment of these signal levels.

ZERO BEAT

The direct-comparison method is satisfactory only when one of the frequencies can be varied and brought to zero beat with the other. When the two frequencies are close in value, an audible beat note will be set up. This is evidenced by a throbbing sound in the headphones or by a fluttering of the deflection of the visual indicator.

At zero beat, the headphone signal disappears, or the visual indicator shows zero deflection. At zero beat, the unknown and standard frequencies are equal.

The direct-comparison method permits measurement of frequency differences of less than 1 cycle per second. The ultimate accuracy depends upon the accuracy of the standard frequency used in the comparison. A shortcoming of this method is its requirement that fundamentals only of the two signals be used.

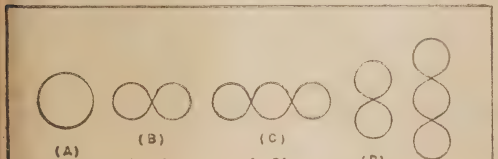
Frequency comparisons by means of an oscilloscope, using Lissajous figures, is superior to the simple method just described. A decided advantage is that the fundamental-frequency relationship is not required. An integral relationship must exist between the standard and unknown frequencies but one may be a harmonic or subharmonic of the other.

Figure 6 shows how an unknown frequency (fx) and standard frequency (fs) may be applied to an oscilloscope having its internal sweep oscillator switched off. The unknown is applied to the vertical amplifier input; the standard to the horizontal amplifier input.

STATIONARY PATTERN

When the frequencies have an integral relationship, either even or odd, the pattern will be stationary on the screen. Figure 7 shows typical patterns.

When the fundamental of the standard frequency and unknown frequency are equal, a circle or ellipse (Figure 7A) is obtained. When the unknown is a harmonic of the standard (as in B and C), a series of connected, horizontally aligned loops is obtained. The unknown frequency then is determined by multiplying the standard frequency by the number of loops.



TYPICAL LISSAJOUS PATTERNS

FIGURE 7

When, instead, the unknown is lower than the standard frequency, a series of connected, vertically aligned loops (such as C and D) are obtained. The unknown frequency then is determined by dividing the standard frequency by the number of loops.

This method is limited only by the number of loops which can be counted on a screen of given size. It may be employed with ease, with a 5-inch screen, for frequency ratios up to 10:1 and with some difficulty at higher ratios.

Since for convenience a calibrated, variable-frequency audio oscillator or signal generator often is used as an adjustable secondary frequency standard for checking frequencies by the oscilloscope method, it is important to note the accuracy and stability to be expected of this type of oscillator.

In laboratory-type instruments, frequency stability and accuracy are maximum: Typical values are frequency accuracy of plus or minus 1 per cent, harmonic distortion of 0.25 per cent or less, and frequency drift negligible after a short warmup period during which it may vary between 3 per cent and 0.07 per cent of the operating frequency.

Service-type instruments offer comparable low distortion but their frequency accuracy is of the order of plus or minus 3 per cent to plus or minus 5 per cent.

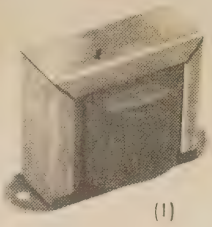
The accuracy and ease of use of the oscilloscope method using loops (Figures 6 and 7) suffer when the number of loops on a 5-inch screen exceeds ten. For higher frequency ratios, wheel patterns may be used with better results.

"WHEEL" PATTERN

Figure 8(A) shows the setup for wheel patterns. Here, the standard audio frequency is applied to an adjustable phase-shifting network, RC. The horizontal and vertical signal voltages are taken from this network. The coupling transformer, T, may be any available interstage audio transformer having a turns ratio of not less than 1 to 1. The internal sweep oscillator of the oscilloscope is switched off.

For a given standard frequency (fs), rheostat R is adjusted for a 90-degree phase shift between the horizontal and vertical signals. This will give a circular trace on the screen. The signal of unknown frequency (fx) then is applied between ground and the intensity modulation (Z-axis) input of the oscilloscope.

This latter signal will modulate the



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OPM15	10	P.P. or S.E. 10000, 7000, 5000, 2500	3.1	2
LINE TO VOICE COIL				
OPM16	10	500	15, 12.5, 8, 3.7, 3.1, 2	1
OPM17	15	500	15, 12.5, 8, 3.7, 3.1, 2	2
OPM18	25	500	15, 12.5, 8, 3.7, 3.1, 2	2

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circular trace, breaking it into a number of bright spots, or segments, as shown in Figure 8(B). The unknown frequency is determined by counting the number of segments (or the spaces between them) and multiplying the standard frequency by this number.

This method is most practical when the standard frequency can be varied. The reason for this is that the circle will rotate and make counting difficult unless fx is an exact multiple of fs. Frequency ratios of 50 to 1, or higher, may be detected on a 5-inch screen.

FINAL ACCURACY

The accuracy of this method, like that of the loop method, depends upon the precision of the standard frequency. Accuracy of plus or minus 1 per cent may be obtained with a good-grade variable-frequency audio oscillator as the standard frequency source.

The Bridge Method depends on the Wien bridge, which has a different null point for each supply frequency. This frequency dependence makes it possible to use the bridge as a simple audio frequency meter in the range 20 cycles to 20 kc.

The dial attached to the ganged variable arms of the bridge may be graduated directly in cycles per second. A direct-reading frequency meter is obtained. It becomes necessary only to balance the bridge and read the frequency from the dial.

In this audio-frequency application, the Wien bridge becomes comparable to the absorption wavemeter used in a somewhat similar manner at radio frequencies.

Figure 9 shows the circuit of the Wien bridge-type audio frequency meter. In this circuit, the main control is the 2-gang potentiometer, R4-R5. While, for simplicity, headphones are shown as the null detector (and may be used), the detector may be an oscilloscope or AC vtvm.

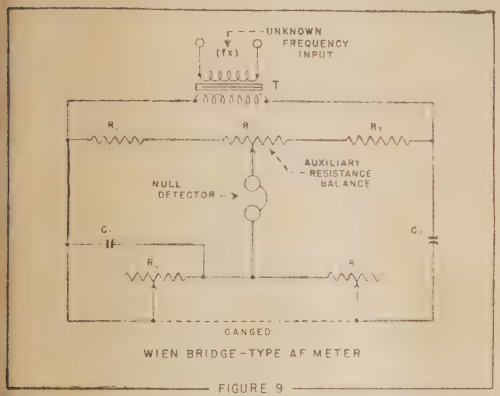
CAPACITORS

Capacitances C1 and C2 are made equal, and R4 and R5 are equal at all settings.

When this condition obtains, the unknown frequency fx = 1/(6.28C1R4); where fx is in cps, C1 in farads, and R4 in ohms. A direct-reading frequency dial is attached to R4-R5. Potentiometer R2 has a very low resistance value with respect to R4 and R5 (usually not more than 1,000 ohms). It serves as an auxiliary resistance balance which deepens the null but does not shift the calibration of the R4-R5 dial.

In practical instruments, the maximum resistances of R4 and R5 usually are 10,000 ohms each. Capacitors C1 and C2 are switched in value simultaneously to change the frequency range. In commercial, the bridge-type frequency meters, the basic range is 20-200 cps. By switching C1 and C2, additional ranges of 200-2,000, and 2,000-20,000 cps are obtained.

The accuracy of the bridge-type frequency meter depends upon the closeness of tracking between R4 and R5, precision of the frequency source from which the R4-R5 dial initially is calibrated, stability of capacitors C1 and C2, sensitivity of the null detector, absence of harmonics in the signal of unknown frequency, and to some extent upon the signal-voltage amplitude.



WIEN BRIDGE-TYPE AF METER

FIGURE 9

Frequency accuracy of 0.5 per cent is obtainable in these instruments.

Just as the bridge-type of meter is comparable to the absorption RF wavemeter, the wave analyser is comparable to the superheterodyne receiver. The wave analyser is a highly selective, heterodyne-type instrument which is continuously tunable throughout the range 20-16,000 cps or 50-50,000 cps, depending upon model and manufacture.

FREQUENCY MEASUREMENTS

While the wave analyser is intended primarily for harmonic distortion measurements, it is convenient also for the secondary purpose of audio frequency measurements. In a manner similar to the tuning of a radio receiver, the wave analyser frequency dial is adjusted for maximum deflection of the built-in vtvm, with the signal of unknown frequency applied to the input terminals of the analyser.

Typical frequency accuracy of a commercial wave analyser is plus or minus 2 per cent plus 1 cycle.

Direct-reading audio frequency meters find application where rapid measurements are required. They are especially useful when the extent of frequency fluctuations must be observed. The direct-reading electronic audio frequency meter has high input impedance and covers the range 20-100,000 cps in several switched ranges. The unknown-frequency signal is applied to a pair of input terminals and the frequency is read directly from an indicating meter.

Deflection of the meter is independent of signal amplitude and waveform over a wide range.

The instrument may be re-calibrated occasionally, when needed, by checking a single point on the meter scale (in each range) against an accurate audio frequency standard.

The vibration frequency of reeds, contractors, certain types of bells, and similar mechanical devices may be determined with the aid of a carefully-calibrated stroboscope. When the flashing rate of the stroboscope illuminating the vibrating or reciprocating device is adjusted to equal the frequency of vibration, the device appears to be motionless.

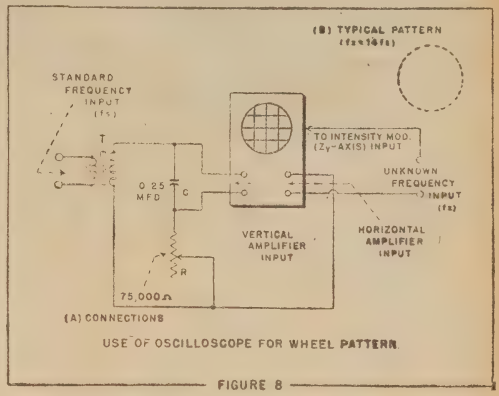


FIGURE 8

At this point, the vibration frequency may be read from the "tuning" dial of the stroboscope.

A signal voltage of unknown frequency may be applied to an audio amplifier provided with a loudspeaker, and the light flashes from a stroboscope directed upon the vibrating cone of the speaker. When the flash rate is adjusted equal to the speaker vibration frequency (which is the frequency of the unknown signal), the cone and voice coil appear motionless.

DIAL READING

The direct-reading dial of a typical commercial stroboscope is graduated in r.p.m. (that is, flashes per minute) between 600 and 14,400. This corresponds to audio frequencies between 10 and 240 cps. Accuracy is plus or minus 1 per cent. However, most stroboscopes are calibrated periodically by their owners by reference to the AC power line, and the accuracy with which the line frequency is maintained in the locality of use will be an important factor in determining accuracy.

Electronic counters, such as decimal scaler and events per-unit-time meter, are used extensively for audio and supersonic frequency measurement. These instruments literally count the cycles in the unknown signal. The frequency is indicated by neon lamps arranged in several decades.

In the second type of meter, the count may be made over a selected time interval, such as 0.1, 1, or 10 seconds. The time base is derived from a temperature-controlled 100-kc crystal oscillator and associated timing circuitry.

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Built on an oddment commercial amplifier chassis, this unit has proved in practice to be well suited to use in a church seating upwards of 200, exclusive of adjacent hall and "cry" room to which sound has to be relayed. It has two pickup and two mic. circuits, 4-channel mixing and a power output of about 25 watts.

Amplifier Systems For Local Churches

We have had numerous requests of late for information on the provision of amplifying equipment for churches. This special article, prepared by the Technical Editor, should provide valuable guidance to anyone faced with the task of installing such a system.

THE purpose of the article is not to present details of a particular installation but simply to discuss ideas and methods in a general way.

The provision of amplifying equipment in a church can be quite a problem, for the following reasons:

(1) Because of the preponderance of hard, acoustically reflective surfaces, unpadded seats and bare floors, most church buildings are subject to echo and acoustic feedback when an amplifier system is installed.

(2) The equipment is likely to be used by people who are untrained in microphone technique.

(3) As well as the above difficulties, the equipment must always be unobtrusive in its operation. Inadequate or excessive level "blasting" hum, clicks or howling due to feedback have a shattering effect on the atmosphere of a church service.

(4) Funds are seldom available to have the installation done commercially. Modestly priced components must be used and installed, as often as not, by a member of the congregation who happens to know something about "radio."

It is largely to assist such folk, that this article has been written.

Before building or buying anything in the way of equipment, it is essential for those concerned to define exactly what the proposed installation will be required to do.

Likely requirements must be defined, as well as complications which could arise from its use. How much can be spent on the project immediately and later? Where will it be installed? What about the mic., speaker and power wiring? Who will be responsible for its operation during services? Who will carry out necessary maintenance?

The initial requirement, usually, is to amplify the preacher's voice. However, almost automatically, various other subsidiary roles may emerge for the equipment.

TYPICAL REQUIREMENTS

The following are typical:

(1) To amplify music as generated by an electronic organ or from a contact microphone inside a reed instrument.

(2) To allow tape or disc recorded music to be played before or after service.

(3) To be used in conjunction with a 16mm film projector.

(4) To be used by a lecturer at the rear of the auditorium, when presenting slides or film-strip.

(5) To power "deaf-aid" headphones.

(6) To operate speakers in an adjacent building or in a sound-proofed "cry" room.

(7) To feed an outdoor speaker with recorded music, electronically generated carillon or amplified speech.

Faced with such possibilities, there is an immediate temptation to provide one powerful central amplifier, with coloured lights, circuits and controls to allow it to perform these diverse functions in the most spectacular possible manner.

It does not follow, however, that such an approach is the best one, no matter how it exercises the ingenuity of its proponent. A too-complex installation can become virtually useless if a technically minded person is not always on hand to operate it.

Much of the success of a system depends on the right choice and placement of speakers, and herein immediate difficulties arise.

To reinforce speech from the pulpit, a loudspeaker ideally needs to be in front of the audience. However, because of acoustic feedback problems, it usually has to be located well to one side of the building.

A loudspeaker carrying sound for a 16mm. film should, however, be positioned as close to the projection screen as possible, high up and directed at the audience to ensure maximum clarity.

"NATURAL" SPEECH

As for speech reinforcement, clarity and "naturalness" are the prime requirements, and a sustained bass response is not essential.

On the other hand, the speaker or speakers serving an electronic organ normally need to be baffled to produce the maximum possible bass response. The middle and high frequencies are best not directed at the congregation, but dispersed and augmented by the building's own natural reverberation.

by Neville Williams

Conflicting requirements thus become immediately evident, and the possible solution of switching the one amplifier to different speakers is not a very satisfactory one. The operator must anticipate the need for each switching operation and must be doubly careful to avoid bringing microphones and speakers simultaneously into circuit, which are prone to feedback.

The writer's advice, at the very outset, is that the amplifier and speaker system serving an electronic organ should not be used for any other purpose, remaining always and solely under the control of the organist.

GOOD REASONS

There are various reasons to commend this, as under:

(1) Organ music, which provides the foundation and continuity for much of the service, cannot be accidentally interrupted by somebody fiddling with amplifier controls.

(2) Since the organ circuit is always intact, the organist can supply background music or cover any breaks in proceedings quite independently of other people's alertness.

(3) Having to serve no other function, the organ speaker system can be placed to give the best possible musical balance for both organist and congregation. If this requirement is not met, the organist has to apply a good deal of guesswork to achieve acceptable balance and to control the singing.

Having provided the organ with its own separate amplifier and speaker system, an attempt can logically be made to cover as many of the remaining functions as are deemed necessary, with a second amplifier system. Within the auditorium proper, these might involve speech reinforcement, reproduction of tape or disc-recorded music, and sound from a 16mm film projector.

It is realised, of course, that most 16mm. sound projectors are complete with in-built amplifier and portable speaker. However, it is equally true that running cables and propping up such a speaker is an irksome business, and there is much to be said for wiring which allows the projector to use a permanent speaker installation, particularly where films are shown fairly frequently.

INTELLIGIBILITY VITAL

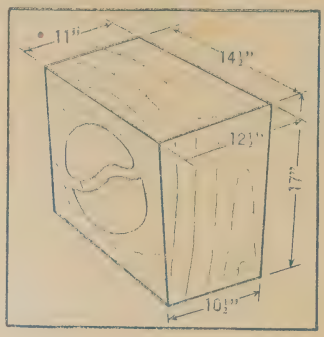
For speech reinforcement and film track sound, as already mentioned, the prime requirement is intelligibility. This involves beaming the higher frequencies towards the audience and avoiding echo, particularly from high ceilings.

Extreme bass is not required, though it should not be attenuated to a degree which will make voices sound noticeably thin. It does mean, however, that the speaker or speaker system need not be housed in a ponderous enclosure, something much smaller being usually quite adequate.

Based on the normal concept of Hi-Fi in the home, it might be thought that such a modest speaker enclosure would be unsuitable for the reproduction of recorded music, but such is not the case.

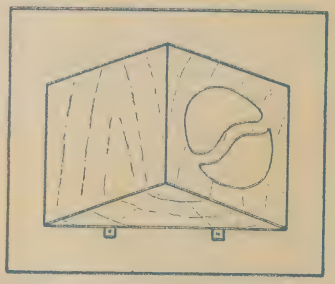
Recorded music is seldom featured in the average church service, its more usual role being as a purely low-level background. The items played are likely to come from all kinds of discs and tapes, ancient and modern, which are a far cry from the usual Hi-Fi enthusiast's hand-picked collection. And, of course, the average congregation contains only a small percentage of people interested in high fidelity for its own sake.

Therefore, unless one is keen to embark on a rather thankless "Hi-Fi Crusade", it is much easier and sufficient, in most cases, to follow the line of lesser resistance. This simply means getting as much bass as possible consistent with a practical size speaker box, limiting the treble by tone control, to suit the occasion (or the record) and avoiding any suggestion of harshness and distortion.



Built of half-inch plywood to the dimensions shown, this box will house a 12-inch heavy-duty speaker. The front is tilted slightly downwards and may also be inclined to one side or the other, as required.

If high fidelity is required for a special occasion, or stereo in these modern times, it is usually much easier to bring along additional private equipment and make it a real feature.



Whereas the box shown above is well suited for mounting on a front wall, a triangular shape is better, if it has to be mounted near the front on a side wall.

For a routine, permanent installation, therefore, the first task is to visualise a modest speaker box and positions which it could conceivably occupy, without detracting from the appearance of the building. It then has to be discovered whether any of the positions are, in fact, acoustically practicable.

This last can only be demonstrated by actual test and the best course is to try to discover possibilities and problems by setting up any temporary equipment which can be got together for the purpose. If the equipment can be used unobtrusively during actual services, so much the better.

It may be possible by such means to discover a position from which a single speaker will serve all functions. The most likely position is high up on the front wall of the church, facing slightly downward toward the congregation and on the side furthest from where the microphone must stand.

If the pulpit is centrally placed, however, it may not be possible to gain sufficient separation between microphone and speaker in this way, in which case, the loudspeaker can be moved somewhat toward the audience along the side wall.

CLOSE TO SPEAKER

In either case, when showing films, the screen should ideally be placed on the side nearer the loudspeaker, to obtain maximum association between screen and voice.

To feed film sound through a common loudspeaker it is obviously necessary either to divert the projector's output into the main amplifier or else to switch the speaker leads over from one amplifier to the other.

In certain cases, it may be preferable to make the speaker box large enough to house two separate speaker units, which can be used quite independently. Thus, although sound comes from the one source as far as the audience is concerned, and although only one box has to be installed, the operator has two independent speaker circuits at his disposal, without need for switching.

For all normal installations, the loudspeaker enclosure should be mounted not less than about 10 feet from the floor-level, preferably higher, and angled so that it points over the heads of those in front, toward the rear seats. Unless it is so placed, those in front of the speaker will get more than their rightful share of its output.

For the average medium-sized church, a single 12-inch heavy-duty speaker will usually be found to be adequate, mounted in a solidly constructed and padded box. A typical box is illustrated herewith. The dimensions given are quite arbitrary, but yield a box which gives reasonable baffling to the speaker without being unduly clumsy.

TRIANGULAR SHAPE

If the speaker needs to be placed on a side wall, as mentioned earlier, a quasi-rectangular shape is not a very convenient one and a basic triangular pattern is often a better proposition. The side carrying the speaker should face out over the audience, the overall dimensions being as large as possible consistent with appearance.

In lofty church buildings, echo effects from the ceiling space often detract from the intelligibility of amplified speech, particularly when only a limited audience is present.

It is an advantage in such cases to limit the angle of sound projection in a vertical plane so that a

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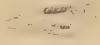

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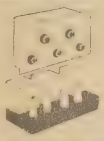

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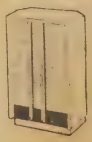

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minimum of sound energy reaches the ceiling space.

This can be accomplished by mounting a flare in front of the speaker cone and sound projector operators have, in the past, often used one or more 8-inch speakers fitted with flat, wide-angle flares, made from plywood. However, there are few cases where such an arrangement can be considered for permanent installation.

An equivalent effect is given by the so-called "sound column" principle. A long rectangular box is used, long enough to house from four to six speakers, one above the other. The speakers may be wired in series or in parallel, according to impedance requirements, but their cones must operate in phase.

BEAM EFFECT

The sound energy radiated from the speakers combines in a horizontal plane, but tends to cancel for angles approaching the vertical. A column speaker can therefore project a flat arc of sound over the heads of the audience.

Within reason, the longer and more continuous the column of cones, the greater is the effect. In some cases, output from the end speakers is reduced slightly, to minimise vertical dispersion, either by using less sensitive speaker units or by shunting them electrically.

A logical course is to use four (or more) oval speakers with their larger axes end-to-end. Four 6in by 9in ovals would make a very husky unit, but for the sake of compactness, four 5in by 7in types might be preferred.

The column-shaped enclosure must obviously be long enough to house the speakers, grouped fairly closely together, but the width and depth can be kept fairly small. The smallest commercial columns are little larger in cross-section than is necessary to house the speakers, while others provide a width of nine inches or more, and almost as much depth.

BASS RESPONSE

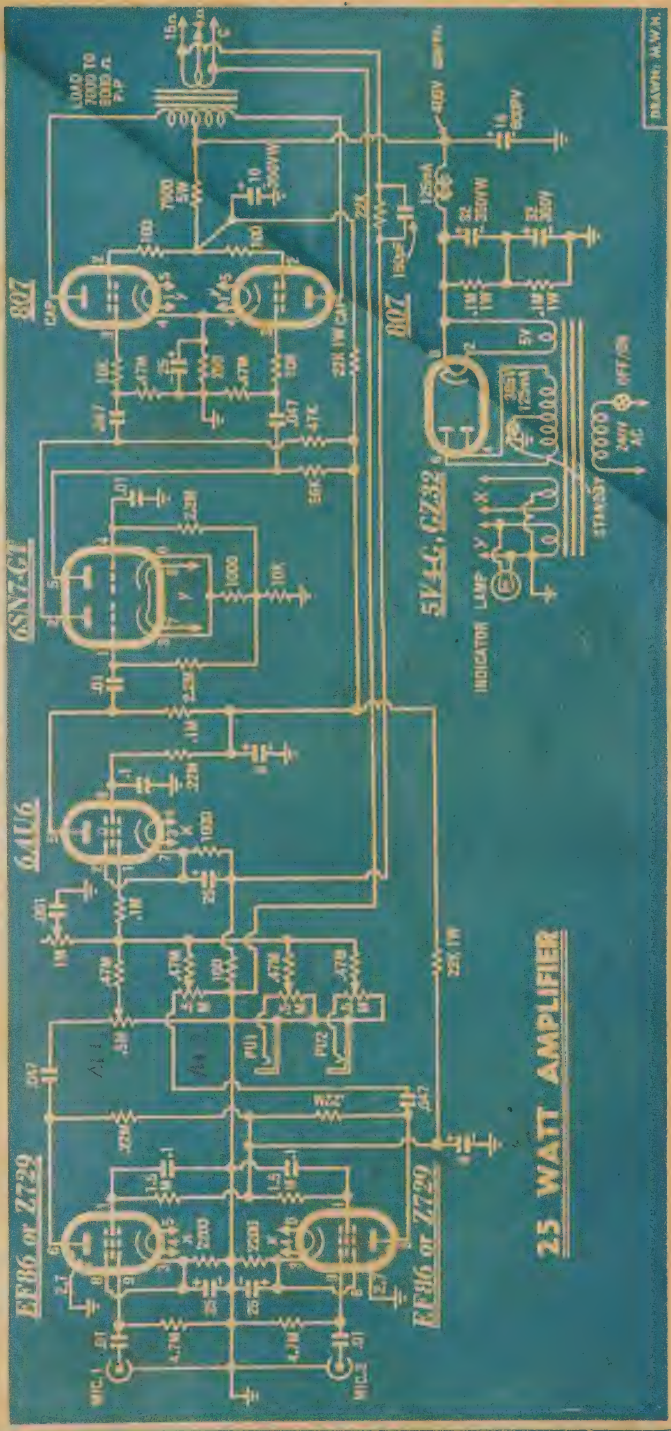
As with any other box, increased internal volume gives a more sustained bass response and there is everything to be said for using as large a column as possible. It should be freely padded internally and a few 1-inch holes drilled in the remote side to relieve some of the back pressure on the cones.

Another advantage of a column speaker is that its shape allows it to be variously featured or blended with surroundings.

Suitably stained and polished, it may be supported off the floor on a pipe standard or a wooden pillar. Alternatively it may be attached to an architectural pillar or else painted and fixed so that it will blend in with a wall.

Thus far, it is to be assumed that only one speaker unit is to be used and, except in very large buildings, one should be sufficient.

However, there may be instances, particularly if more than usual acoustic damping is present, where two speaker



While it is very nice to start off with all new and modern components, an amplifier like this can often be put together much more cheaply from parts which interested members may have on hand.

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nits can be employed, one near each of ie front corners. Such an arrangement an give excellent results, largely be-ause the sound source is diffused and iore easily related to the preacher or nger.

In many more cases, however, just ie reverse is true, in that acoustic feed-ack is present with even a single loud peaker unit, no matter what its type, ocated anywhere near the microphone osition. If amplification is to be used t all, in such circumstances, the loud-peaker must clearly be placed in a iore remote location.

Mounting it on a wall behind the audience may solve the feedback problem forthwith but creates the incongruous and undesirable situation of a loud voice quite unrelated to the person who is speaking.

In such a case, it is often much bet-r to forget altogether the idea of using major loudspeaker unit and concen-ate instead on a number of speakers, perating at low level and distributed roughout the auditorium.

OUND EVERYWHERE

While the output of individual loud-peakers may predominate in different reas, the effect sought is to "surround" ie audience with sound so that the dis-ociation of the sound source and the eacher is more readily overlooked.

For such an effect, at least four peakers are necessary but, since each is tended mainly to serve a local area, naller, less expensive units can be used. x-inch to eight-inch speakers are gen-ally quite adequate.

Three mounting positions suggest emselves for speakers in the audi-rium proper. The first is in baffle oxes, fastened high up on the side walls id mounted so that their fronts face own toward the centre of the seating rea. The speakers should be staggered that they do not directly face each her across the auditorium.

A second possible position is above é ceiling, with the cones facing rough holes directly down into the e auditorium. While it calls for some solution and skill to cut holes in the iling, the final installation can be made ite unobtrusive if the holes are suit-ly dressed on the underside.

AFFLE BOARDS

Unless the ceiling material is substan-al, the speakers will have to be mount-l on flat baffle boards bracketed to the fters and flush against the ceiling sur-ce.

The rear of such speakers should be nclosed by internally padded boxes (a) prevent echo effects in the roof area:) to protect the cones from wind-gusts hich may cause different pressures ove and below the ceiling and (c) to otect the rear of the cones from dust. rds or rodents.

To ensure best propagation of low equencies the speakers should be inter-nnected so that their cones all move phase. This is best done before the peakers are mounted in position by iring them temporarily together and oting whether all cones move the same ay when a battery is connected across ie line. The same polarities should be bserved for the final installation.

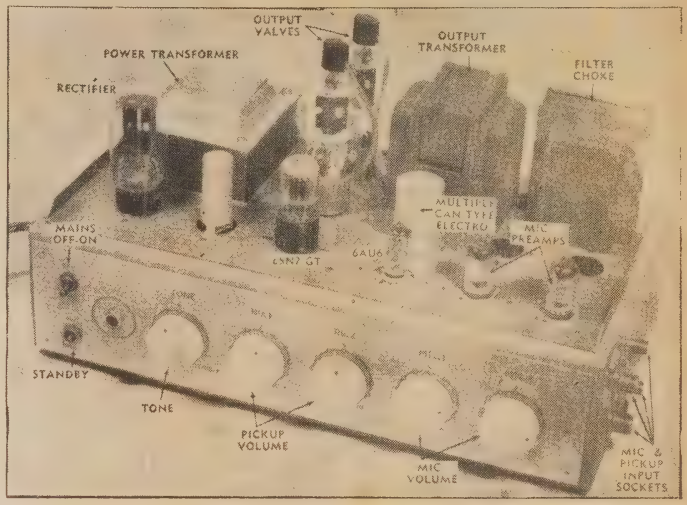
The matter of wiring and controlling peakers will be mentioned later in the rticle.

It might be inferred from the foregoing that acoustic feedback is simply a matter of speaker placement, but such is not necessarily the case. The placement and type of microphone used is also important.

In fact, of course, the general position of the microphone is largely predetermined by the speaking position, though some movement may still be possible. It may be that some benefit will result from placing the microphone to one side or the other, rather than directly in front of the pulpit.

The overall gain of the system usually varies with frequency and feedback normally occurs first at the point in the spectrum where the gain is highest. At other frequencies the gain, and, therefore, the sound, volume may be well below the level necessary to produce feedback. There is, therefore, a special advantage in avoiding peaks of gain anywhere in the system.

With almost any modern amplifier there is very little change in gain with frequency and the type of amplifier.



This top view of the amplifier chassis, shows the position of the valves and major components. Mic. and pickup input sockets are on the end of the chassis, speaker outlets at the rear. See circuit and text re. input wiring to obviate eddy current effects.

Placing the microphone at near to face height and very close to the preacher will secure maximum sound pickup and avoid the need for advancing the amplifier gain too far. Acoustic feedback problems can thus be simplified.

However, close placement of the microphone can be distracting to the preacher, and also restrictive, if he attempts to maintain a constant speaking distance. If he doesn't do this, or doesn't compensate speaking distance by voice control, the level of the voice through the amplifier will vary in the most disconcerting fashion, with every movement of his head.

If the microphone is lowered and moved further away it becomes less obtrusive and much less sensitive to changes in the preacher's position. However, since the sound pickup is reduced and the amplifier gain needs to be increased, acoustic feedback is likely to become more noticeable, as also will echoes from within the building.

The final position will always be a compromise between these factors.

In principle, acoustic feedback howling will occur when the microphone can receive enough sound from the speaker for it to be amplified and reappear in the speaker at its original level or greater. The level at which feedback will become evident is, therefore, a matter of overall gain, involving the amplifier, speaker, microphone and the intervening acoustic path therefore, has no great bearing on the acoustic feedback problem.

The loudspeaker is more significant, because speakers do have peaks in their response. The acoustic feedback path may also be frequency-conscious.

By and large, however, these lastnamed factors are more contributory than otherwise, the chief problem usually being response peaks in the inexpensive types of microphone which it may be necessary to use.

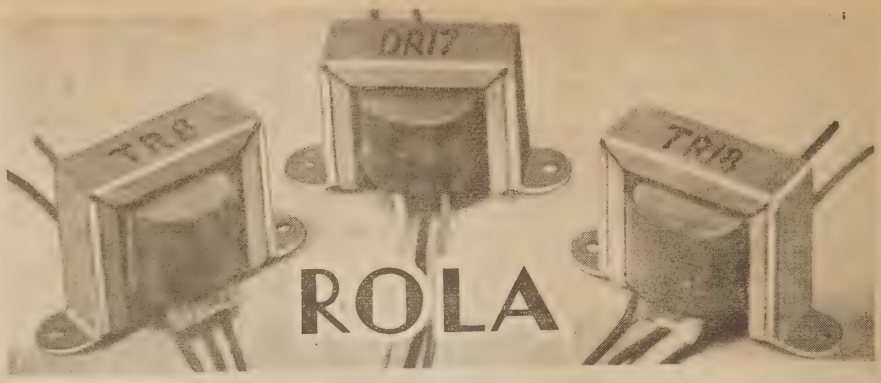
The cheapest types of crystal insert, together with some of the older ribbon and dynamic types, have mostly suffered with very obvious peaks, no matter how expansive the descriptions of them.

MICROPHONE QUALITY

The quality of a microphone can be judged fairly well, in this respect, by setting it up in front of someone whose voice is known fairly well to you, then listening to the amplified result in another room through a properly baffled loudspeaker (This last point is important.)

If the speech quality is unnaturally tinny or harsh or metallic or lisping—to use everyday adjectives—the chances are that the microphone has one or more treble peaks. If it is "woolly" and indistinct, the chances are that it lacks high frequency response.

With a reasonably level microphone, the person's voice will sound natural, and it should be possible to walk from the room where he is talking to the one



TRANSISTOR TRANSFORMERS

These transformers have been designed in the Rola Laboratories specially to meet the requirements of Australian radio set manufacturers for highly efficient driver and output units which provide a good frequency response when used with standard type low-powered transistors.

They are intended to operate into a standard 3.5 ohm impedance loudspeaker voice coil. In addition to Types DR17 and TR18 which have been designed for transistor portables, Rola also makes other types of transistor transformers. Specifications of some of these are listed below.

ROLA TRANSISTOR TRANSFORMER SPECIFICATIONS

TYPE	DESCRIPTION	IMPEDANCE OHMS	OUTPUT POWER 6 v.	OUTPUT POWER 9 v.
DR17	Driver transformer	3,000 — 2,000 c.t.		
TR18	Output transformer	375 c.t. — 3.5	175 mW	300 mW
DR4	Driver transformer	3,000 — 1,300 c.t.		
TR7	Output transformer	420 c.t. — 3.5	150 mW	250 mW
TR8	Output transformer	300 c.t. — 3.5	200 mW	375 mW

HIGH EFFICIENCY LOUDSPEAKERS

Two small high-efficiency Rola loudspeakers have already been developed for use with transistor or conventional battery-operated receivers and amplifiers. Others are on the way. For transistorised portables use a Rola Model 5F. For miniature transistor receivers we recommend the new Model 4C-05A fitted with an F44 diaphragm. This speaker measures only $4\frac{1}{8}$" overall by $1\frac{3}{4}$" deep, is light in weight—only $6\frac{3}{4}$ oz. (without transformer), yet has an efficiency equal to that of the earlier Model 4F. Its low cost, small dimensions and light weight make it ideal for miniaturised battery or transistor receivers.

ROLA COMPANY (AUST.) PTY. LTD.

containing the loudspeaker, without noticing any startling change in voice timbre.

Apart from the very peaky "speech" inserts and microphones just mentioned, most manufacturers have inexpensive units available, in which an attempt has been made to level out the response.

Thus, two or three types of "wide-range" crystal cartridge are listed, retailing for about 50/, which are tolerably good on speech and vocal items. They can be purchased separately or form the basis for complete microphones selling for a few pounds each.

Some of the later models of dynamic or velocity microphones, retailing for round about £10, are also flat enough to be useful for routine amplification. Above this figure again, it is possible to buy cell-type crystals and better types of dynamic and velocity for something between £10 and £20.

POSSIBLE SAVINGS

Some saving may possibly be effected on these figures if trade discount can be secured and also exemption from sales tax on the grounds that the microphone is not for resale but is to be used during Divine services. The same remark applies, of course, to other items of equipment.

Be that as it may, however, money is well spent on the best possible microphone, benefits including extended and smoother frequency response, lower inherent distortion, and greater freedom from acoustic feedback.

Of the types likely to be considered, crystal microphones offer high relative output, suitable for feeding directly into a preamplifier grid circuit. This advantage diminishes, however, if a long connecting cable has to be used; while not affecting frequency response to any extent, the extra capacitance does reduce output rather drastically.

The distance between a crystal microphone and amplifier may be increased by extending the lead with low-capacitance wartime coaxial cable, which some hobbyists may still have on hand. The technique, in the writer's experience, is usually successful up to about 30ft but, beyond that, the loss of effective mic. output and the appearance of 50 cps induction in the cable leads to serious hum problems.

OUTPUT TRANSFORMERS

It is possible to buy crystal microphones, fitted with special step-down transformers, allowing them to feed into long cables. However, the cost is relatively high and, where such need arises, it might be considered that the money better spent on a velocity of dynamic type, which, amongst other things, are less prone to damage by heat and humidity.

Velocity (or ribbon) microphones have relatively low output and are not suitable for use out-of-doors, where wind pressure might distend the ribbon. However, they have a zone of very low pick-up on both sides and acoustic feedback can often be minimised by mounting the microphone edgewise to the loudspeaker. Their naturally flat response characteristic is a further advantage in minimising feedback.

Dynamic microphones are generally robust and reliable and not greatly affected by wind, heat or humidity. Their output is intermediate between crystal and velocity types, being therefore very useful as general purpose units.

Where the connecting cable is relatively short, say about 12ft, velocity of dynamic type microphones can be used with built-in mic.-to-grid transformers, the cable then feeding directly into the grid circuit of the preamplifier valve.

For longer cable runs, it is desirable to purchase a microphone suitable for feeding into a long shielded line, which is then terminated adjacent to the amplifier, in a step-up transformer. This last component should ideally be very thoroughly shielded; if not, it may need to be located several feet from the nearest power transformer to minimise hum pickup.

For playing recorded music in a church, a standard 3 or 4-speed pickup and turntable is normally adequate, using a turnover crystal cartridge or a turnover ceramic, if it is likely to be subjected to undue heat.

As suggested as earlier, the requirements for recorded music in a church and the motley array of records, which might need to be played, render expensive equipment rather pointless. At the same time, it must be able to play records of all types.

Column speakers produce a broad, horizontal beam of sound and are therefore useful in lofty buildings. In addition, their shape makes them easy to accommodate and, if the column feature is not essential, they can house two or more speakers used for different purposes.

An automatic record-changer would have some advantages but is too prone to abuse in unskilled hands. The writer's preference is for an ordinary playing deck, fitted with auto stop, so that it can switch itself off if there is no one on the spot to attend to it.

It is usually possible to find a handyman in the church who will build an attache style case for the unit, so that it is properly housed, yet portable.

Although reference has been made earlier to reproduction from tape recordings, activity in this field is so limited as scarcely to warrant provision of a permanent tape playing deck.

TAPE MACHINES

Once again, the writer's experience has been that people with tapes to lend usually have a tape machine which can be brought along for the occasion. The important thing is to have a facility whereby its output can be fed through the main amplifier and into the main speaker system, with the least possible fuss and bother.

At the beginning of the article, various other possible uses were listed for amplifier equipment in a church. It is not proposed to comment at any great length on these, mainly because the requirements are fairly obvious.

There is thus not likely to be any great problem in providing a microphone for a lecturer near the rear of the auditorium. At such a distance from the front loudspeaker, no feedback should be evident and, by keeping the amplifier gain fairly high and encouraging the lecturer to speak fairly quietly and close to the microphone, his voice will appear, for most of the congregation, to come from the vicinity of the screen.

The only likely problem will be that of running a lead from the microphone to the amplifier position and earlier remarks about permissible length of cable will apply.

With properly amplified speech, the need may not arise for deaf-aid headphones, since most people who are hard of hearing prefer to find a good listening position rather than make themselves conspicuous by using a headphone.

HEADPHONES

Where one or more headphones need to be operated, they can usually be connected to the speaker wiring, impedance values being manipulated to give the right approximate level. Thus, low impedance phones (50 to 200) ohms may operate at ample level across a 15-ohm voice coil circuit. With a higher impedance circuit, high impedance phones would be better, fed possibly through a makeshift step-down transformer.

Local control of level in the phones can be secured by means of a wire wound potentiometer several times the nominal impedance of the line, wired across the line and feeding the phones.

A similar method of local volume control can be used for a speaker serving the "cry" room, which is becoming a feature in many churches. The speaker for this purpose needs only to be quite small, mounted in a small box and with no pretence to fidelity.

If the level is too high or the sound quality too arresting, it will only disturb children whom somebody is trying to get to sleep. The speaker, therefore, needs to be wired to the amplifier in a way which will give it only a small proportion of the total output, with a local rheostat to reduce the volume further, if necessary.

IN ADJACENT BUILDING

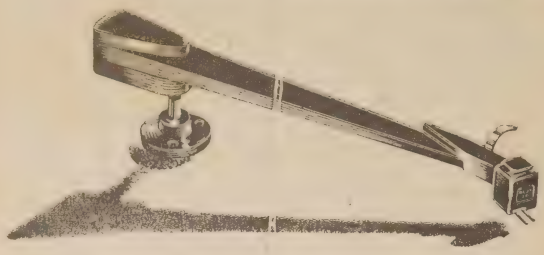
A speaker serving an adjacent building will need to operate at the same level, by and large, as one in the main auditorium, so that it can be fed electrically in parallel with it. A modest enclosure should be sufficient and it can be located in the most advantageous position with respect to the audience.

If an outdoor speaker is required, it, too, will need to operate at equivalent level and can, therefore, be connected across the main speaker line. If this speaker is to be left permanently out of doors, it must be of a suitable type or enclosed in a weatherproof-type housing. The speaker manufacturer's advice should be sought on this point.

When planning the basic amplifier, it is a sound scheme to provide it with a 500-ohm output transformer, having a variety of lower impedance tappings. Speaker leads can then be run over any likely distance and with almost any avail-

A new concept in crystal PICK-UP design by acos

THE BLACK SHADOW



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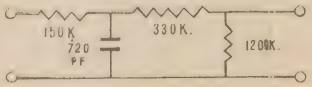
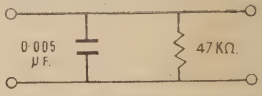


FLAT CHARACTERISTIC
The output from the Pickup is fed through the above network.



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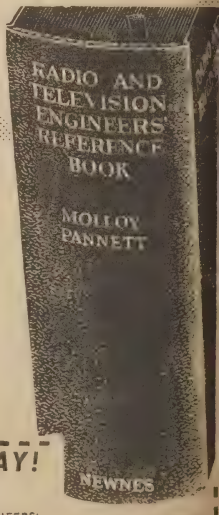

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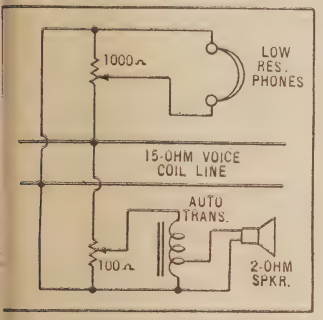
able wire without danger of resistive or capacitive loss.

Speakers intended to operate at maximum level can logically be fitted with 500-ohm transformers and connected to the amplifier so that loading is about optimum when all speakers are being powered. Thus two 500-ohm speakers operating in parallel would connect across the 250-ohm tapping, three in parallel would connect to 160 ohms and so on.

Speakers requiring only a low-level sound, as in a "cry" room or a monitor adjacent to a sound projector, can be fitted with higher impedance transformers —say, 2,500 ohms—and or connected across as much of the secondary winding as is necessary to give the correct relative level.

If the amplifier has a substantial degree of negative feedback applied, it will show very little reaction in general level to loading and it should be possible to switch speakers in and out of vary their individual volume with poten-



The volume in earphones or low-level extension speakers can be controlled locally by potentiometers and auto transformers as shown. For higher impedence lines, higher value pots. are required and regular speaker transformers can be used to adjust impedence values.

iometers, with little change in volume lsewhere.

However, to avoid loss of power due o mismatching, it is desirable to arange matters so that the total loading n the amplifier is about optimum, or little lower, with all speakers in circuit. The load will then rise, as speakers re switched out, but the level in the emaining speakers should remain fairly onstant.

If circumstances are against the use f medium impedance speaker lines, extended wiring can be used at voice coil mpedance, provided the total DC resistnce of each section of the wiring is mall compared with the nominal load vhich it is feeding.

By using twin plastic flex, VIR or ough rubber-type electrical wiring, this ast requirement can be satisfied easily nough for 15-ohm voice coil circuits but -ohm circuits have to be treated with a reat deal more caution.

Next month we will continue this discussion and also make a few practical ointe about the amplifier pictured at the ead of this article.

(To be continued.)

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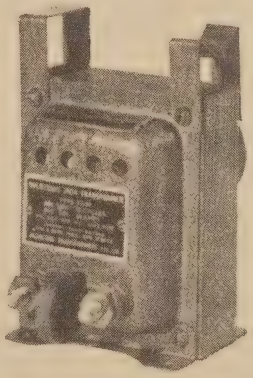

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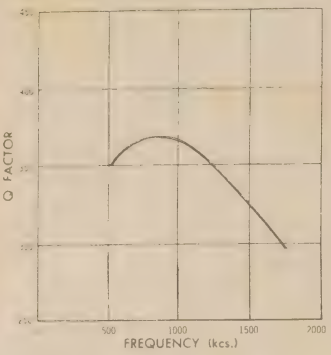
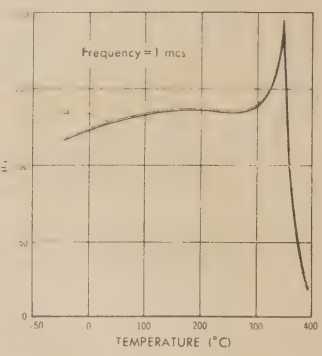


The figure above depicts variation in 'Q' with frequency for a uniform solenoid 6½" long on 8" cylindrical rod.



The figure above shows the variation of initial permeability with temperature. The peak represents the Curie point.

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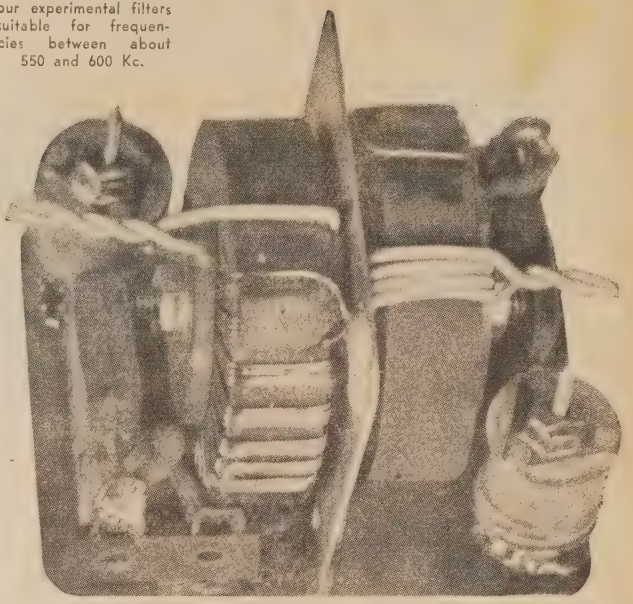
HIGH SELECTIVITY DUE TO NEW FERRITE CORES

Photograph of one of our experimental filters suitable for frequencies between about 550 and 600 Kc.



Earthy ends of the windings are at the top in order to minimise electric coupling between coils Magnetic coupling is negligible due to toroidal windings. Number of turns on input and output link depend on internal impedance of drive source and following stage respectively.

High quality ferrite toroids permit the construction of selective filters operating at radio frequencies. Components are cheap, the design very simple and the performance extremely good. This article discusses theoretical aspects of the filters and details some of the practical work we have had an opportunity to do during the month.

by Maurice Findlay

THE original problem was to design a filter to operate at a frequency within the broadcast band and to have a high degree of selectivity. The filter was required to increase the selectivity of the receiving system in the mobile amateur radio unit described in the October issue.

However, the performance of the filter proved to be so good that we feel it will have application in many receivers for increasing selectivity and performance generally. At one extreme, it may permit the construction of a selective crystal set and at the other make possible a selective single superhet receiver with a high IF and hence good image rejection characteristics.

Used at the normal IF of 455 Kc. a filter of this general design will provide many of the advantages of a crystal filter at a fraction of the cost.

The basis of the filter is a ferrite toroid. Before discussing its design in detail we could well take a little space to explain some of the properties of ferrite materials and the reason for the toroidal construction.

Magnetic cores are used in transformers, chokes and radio frequency coils to increase the inductance of the coils, for a given number of turns, and also to enable tight magnetic coupling between the coils. Although inductance is increased, the presence of the core often results in an undesirable loss of energy due to eddy currents.

For low frequencies, it is satisfactory to use a laminated core, insulating the laminations from one another so that eddy current flow is restricted.

As the frequency is increased, it is found that the losses of the circuit increase as the square of the frequency and in practice ordinary laminated iron cores are useful only for relatively low frequencies.

REDUCING LOSS

There are two basic methods of reducing eddy current loss at high frequencies.

The first is to reduce the thickness of the lamination. Obviously, there is a limit to the practical thinness of a lamination and since insulating material is required between laminations, the ratio of magnetic material to insulating material becomes less as the thickness of the laminations is decreased. The core then becomes less effective.

A practical variation of this idea which is used for coils operating at low radio frequencies is to grind metallic magnetic materials up into a fine dust, mix them with an insulating binding material and mould the resulting mixture into a core of the required shape.

Each particle should be insulated from its neighbour, if the process is correctly carried out, and the eddy current will result in a small power loss. The disadvantage is that the effective permeability of the core is reduced because of the effective air gap introduced by the presence of the binding material.

With this technique, it is necessary to strike a compromise between permeability and the upper frequency which can be employed with low losses. If the core is to be useful over the entire broadcast band it is difficult to make the permeability much greater than about 15.

HIGH RESISTIVITY

A second technique for reducing the losses of a magnetic core is to use a material which has a high resistivity. Metallic magnetic materials have been tried but the best results achieved have not been very encouraging because the increase in resistivity obtainable for a given permeability is small.

Non-metallic magnetic materials were first tried early this century but it is only during more recent years that they have been the subject of concentrated development work.

This work has resulted in a number

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• CONSTANT SPEED CHANGE CYCLE ON ALL RECORDS

The change mechanism is driven direct from the motor, giving a constant speed change cycle, irrespective of the type of record being played. The drive to the turntable is thus not involved in driving this mechanism and is not therefore subjected to the comparatively heavy loads imposed during the change cycle. In consequence the accurate driving surfaces of the pulleys are preserved without wear or damage.

• SPRING MOUNTED

The spring mounting of the Record Changer Unit Plate has been designed to ensure that the unit remains level, whatever the number or weight of records being played. Two holes are provided for screws to hold the unit for safe transit. These screws should be removed before the changer is used.

• FREEDOM FROM STALLING

The simplicity of this machine and the patented cam design are both responsible for the elimination of all heavy frictional loads and safely permit the use of a low wattage motor which is comparable with transcription practice.

• MANUAL PLAY

A single record may be played by using the manual control, the pick-up being placed on the record in any desired position. After playing a record in this manner the machine automatically returns the pick-up to its rest and switches off.

• RELIABILITY

This record changer requires a minimum of service, and adjustment should not be necessary. It is recommended that if adjustments are required, due to mishandling or accidental damage, the record changer be returned to your usual retailer or direct to the manufacturer.

• COLOURS

The changer is supplied in any of four colour schemes: All cream finish with maroon turntable mat OR all maroon finish with gold unit plate and turntable rim OR all maroon finish with cream unit plate and turntable rim OR all brown finish with mushroom unit plate and turntable rim. This changer is supplied complete with disc type operating instruction card firmly attached to the spindle.

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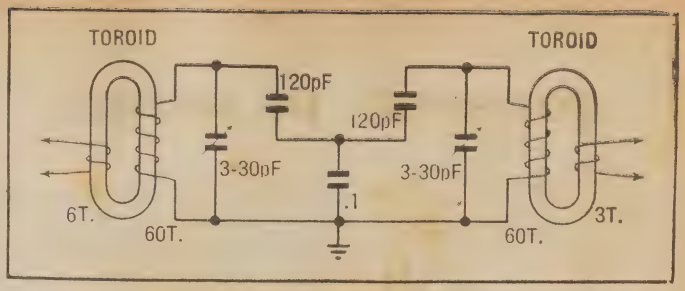
f chemical compounds with a very low due of electrical conductivity, high ermeability and reasonably high values or saturation flux density. It is these ualities we have been able to use in the F filter to be described in this article.

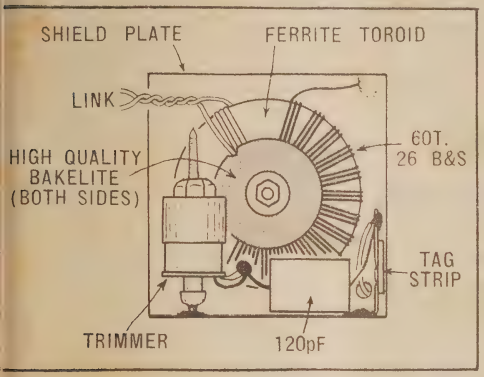
The particular material we have used a nickel-zinc ferrite known as Q Mate- al and commercially available from ucon General Ceramics, a subsidiary Ducon Condenser Limited. It is one a number of ferrite materials made Ducon, some of the others having a gher permeability and being suitable r lower frequency applications.

Q Material is suitable for frequencies to 10 Mc and has an initial permea- ility of about 125. The maximum rmeability is 400 and the saturation x 3,300 gauss.

The manufacturers would probably t wish to divulge all details of chem- al composition and processing of their aterial but briefly, the compound is ade of the required shape by extru-



Circuit of a filter suitable for operation between 550 and 600 Kc. Number of turns on the input and output link depend on impedances of external circuits. The suggested values are suitable for the amateur band converter.



Suggested method of constructing filter. Brass was used for the shield plate and base in the original because it permits easy soldering.

on or pressing and then dried at a low mperature. The process is completed firing the material at a temperature from 1200 to 1400 degrees C (2,200 2,600F) when it appears in a vitrified rm and the general mechanical and sulating properties of a ceramic.

It is essential to remember the latter hen handling ferrites because they are ely to be broken if dropped or sub- cted to other concentrated mechanical ock.

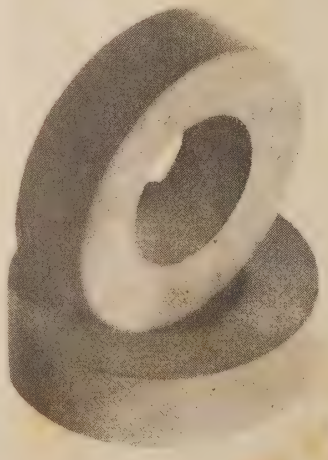
Apart from its use in filters, this and milar ferrite materials have proved very opular for aerial rods of broadcast re- ivers, cup cores for IF transformers, rmeability tuning cores for car radio ceivers, threaded cores for HF coils, lun transformers and many other ap- ications.

ING SHAPE

For the present, a ring made of the aterial is particularly attractive since e coil can then be wound in the form a toroid. This is done by passing e wire through the centre of the ring, ound the outside and through the cen- e of the ring again, continuing in this shion until the desired number of turns e wound on.

Toroids are avoided commercially here possible because it is either a very dious job to wind them or a special pensive machine is required. How- er, it has the considerable advantage at magnetic flux resulting from cur- rent in the coil is almost entirely con- fined to within the core.

In practice, this means that there is rarely any need to magnetically shield the coils and that they can be placed close to metal panels, chassis, etc., with- out causing eddy currents to flow in the panel and hence increase the losses.



Two samples of the ferrite rings used for the filter. The dimensions are approx. 1¾in outside diameter, 11/16in ID and ⅜in thick. Ducon General Ceramics "Ferramic Q" is the material and the part No. is F4021.

Note that electric coupling between adjacent coils is still possible and if two toroids are to be placed close together some form of electrostatic shield is necessary. This can be a thin piece of brass, copper or even mesh.

Due partly to the method of winding but mainly to the qualities of the particular ferrite, a coil wound in this manner will have a very high Q. Manufacturer's data suggests that the Q will be about 400 at frequencies up to about 2 Mc, but measurements we have made have given even better figures than this and we can only suggest that the data tends to be conservative.

The significance of the high Q is evident from the diagram which gives the relation between bandwidth, centre frequency and Q. For a centre frequency of 600 Kc and a Q of 400, the total bandwidth of 3 db down will be a 1.5 Kc or, if the coil were resonated at 455 Kc, the bandwidth would be a little over 1 Kc.

Some damping is unavoidable because the high Q circuit must be coupled to preceding and following circuits. However, if the one high Q circuit does not provide sufficient selectivity for the particular purpose, a number can be coupled in cascade.

COUPLING METHODS

The method of coupling between circuits can be varied to suit requirements. By overcoupling circuits, a flat-topped characteristic with steep sides can be obtained, while critical coupling gives maximum gain if this should be the requirement.

If gain is not a problem but maximum selectivity is required, it is best to design the coupling network to give about half critical coupling, when the selectivity will be virtually as good as if the circuits were not coupled. The drop in gain at the centre frequency is not so great, being about 0.8 of the maximum value obtainable, that is, with critical coupling.

Ordinarily, a convenient method of coupling two tuned circuits is to place them close to one another, choosing the distance so that the desired degree of magnetic coupling is obtained. Magnetic coupling in this manner is not possible with the ferrite toroids because the external field is extremely small.

Link coupling can be used and may be convenient when it is necessary for the circuits to be well separated physically. However, even a single turn link results in overcoupling in the case of the high Q toroids and it is necessary to insert

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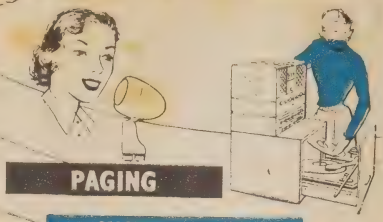

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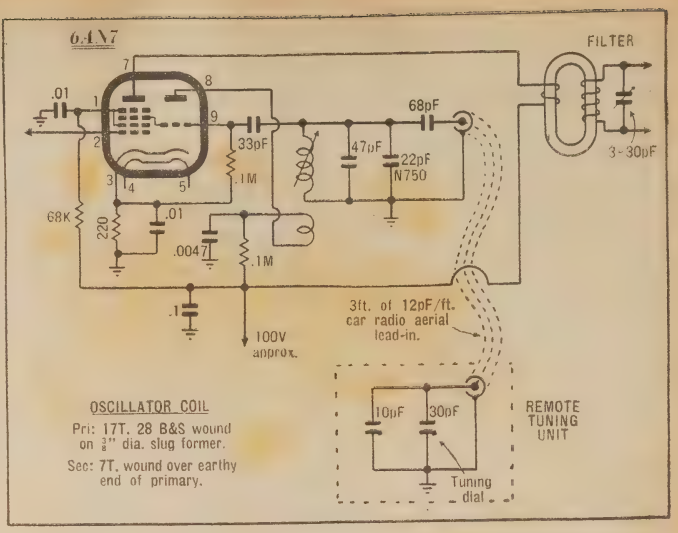
apacitor in the line to reduce the
pling to critical or below.
op coupling, that is, coupling of two
nits by means of a small capacitor
veen the top of the circuits, is often
but may be impractical in the case
high Q circuits because values of
order of a fraction of 1 pF may be
uired and such values are not easy
ontrol.
Vith bottom coupling, the tuning
acitors for each circuit are returned
common point and thence to earth
a large value capacitor. The larger
-value of this capacitor the lower
coupling. Values tend to be more
etical and the amount of coupling
usually be controlled readily.
rom the theoretical aspects of the
ect, we now come to the design of
ractical filter.

CEIVING

he receiving system of the amateur
smitter/receiver described in the
ober issue consists of a crystal-con-
ed converter feeding into a broad-
receiver which is employed as a
able intermediate frequency channel.
tuning the dial of the broadcast re-
er it is possible to tune over the
t-wave band.
lthough the system results in excel-
stability, gain, etc., it suffers the
dvantage that the intermediate fre-
ncy channel of the broadcast receiver
ot selective enough to separate sta-
s on the crowded high-frequency
teur bands.
Good use of the gain of the broad-
receiver, its audio amplifier, speaker
power supply can be made if a
able oscillator is substituted for the
crystal oscillator, a selective filter
rted between the converter and the
adcast receiver and the broadcast re-
er tuned to the frequency of the
r.
he exact frequency of the filter is
thy of some consideration. For best
ctivity, it should be as low as pos-
e and on this consideration alone any
uency between about 550 and 600
would be suitable.
lthough interference from local
adcast stations has not proved a
blem in the original installation, it is
l policy to avoid tuning your filter
he frequency of a powerful local.

OM OSCILLATOR

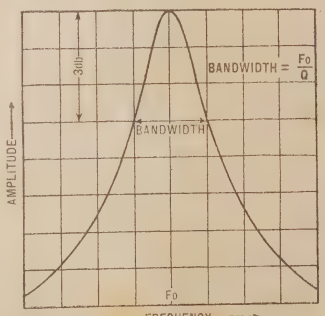
nother possible source of spurious
nals is the local oscillator of the
adcast receiver. This normally oper-
at a frequency of 455 Kc higher
n the incoming signal and there is
nger of the 7th harmonic interfering
h signals on the 7.00 to 7.15 Mc
l if the filter frequency is between
t 540 Kc and 570 Kc. Provided
e are no strong broadcast stations
our near vicinity operating on the
uency, the filter can well be tuned
ny frequency between about 580 and
Kc with little danger of undesirable
onses.
/e come now to the job of making
actual filter.
he main requirement is that there be
ppreciable electric coupling between
two coils. We have satisfied this by
unting them on opposite sides of a
s. partition which is perpendicular
nd in the centre of a brass baseplate.
high potential ends of the coil are
ed close to the baseplate and the
pling between the coils due to stray
ctric fields is negligible.



Suggested modifications to the receiver oscillator section of the mobile transmitter/receiver described in the October issue. The variable oscillator operates on the low frequency side of the signal. Constants given are suitable for a first IF between about 550 and 600 Kc.

There would be some virtue in designing the circuit for a high ratio of C to L but it is convenient to use a standard 3 to 30 pF trimmer and C/L must be reduced so that a reasonable tuning range can be obtained, both to allow for tolerances in the permeability of the material and to permit the centre frequency of the filter to be varied.

Requirements were satisfied by winding 60T on the toroid (Ducon Part No. F4021) and tuning with a 120 pF silver mica capacitor in parallel with a 30 pF trimmer. Calculations confirmed by practical checks showed that the required



This diagram shows the relationship between bandwidth, centre frequency and Q. For a narrow bandwidth (good selectivity) either the centre frequency should be low or the Q of the circuit high.

degree of bottom coupling could be obtained with a 0.1 uF capacitor. This incidentally should be a paper type because of the wide tolerances on certain ceramic capacitors. The lowest voltage rating obtainable will be satisfactory.

It is convenient to solder the moving plates of the trimmers to the baseplate so that only the 120 pF capacitors are directly concerned with the coupling between the two circuits but the coupling co-efficient is little affected since the trimmer is only a small porportion of the total capacitance in circuit.

The toroids are mounted on opposite sides of the metal partition by means of a single bolt. High quality bakelite or polystyrene discs should be used to insulate the windings from both the partition and metal washer. The dynamic impedance of the circuit is of the order of 1 megohm and only a small leakage current would be required to spoil the efficiency of the filter.

EFFECT OF DC

The effect of DC flux in the toroid appears to be negligible, at least up to the values likely to be required for coupling valve circuits and therefore the coupling coil can be wound directly on the toroid without the need for shunt feed.

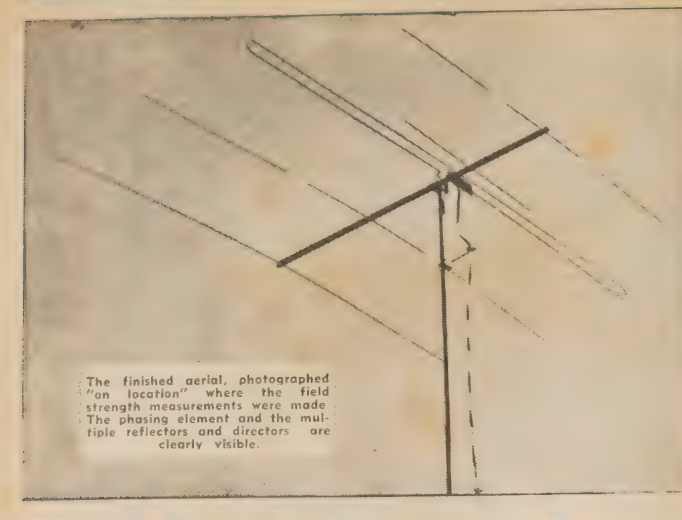
The number of turns you require for coupling both in and out of the circuit depends on the plate resistance of the preceding valve and the impedance of the following circuit. The number we have shown on the diagram gave reasonable gain and little damping of either circuit.

The practical results obtained were really excellent considering the simplicity of the circuit. With a centre frequency of 590 Kc, the attenuation at 1 Kc off resonance was about 4 db and at 2 Kc off resonance 12 db.

With two amateur stations of about equal strength beating at about 2 Kc it was possible to tune either with little interference by tuning to the side while the beat was strongly evident if the receiver was tuned between the two.

Obviously selectivity of this order does attenuate the higher frequency voice components but not so much as to make

(Continued on page 119)



The finished aerial, photographed "on location" where the field strength measurements were made. The phasing element and the multiple reflectors and directors are clearly visible.

Building Your Own Television Aerial

Making TV aerials appears to be a popular pastime among our readers, if the number of enquiries we receive on the subject is any indication. Here are two designs which, between them, should cover most requirements short of actual fringe area conditions. Both should be well within the constructional capabilities of anyone reasonably handy with ordinary tools.

IN the November, 1956, issue we featured a general discussion on TV aerials; their requirements, the basic problems involved in satisfying them, and the approach to these problems as exemplified by typical overseas designs.

We followed this in the December issue with a practical description of a simple fan-type aerial; a design which we considered to be an excellent compromise for the home constructor, being mechanically simple, yet based on sound electrical principles and capable of perfectly adequate performance in most ordinary localities.

SOUND APPROACH

In practice our ideas appear to have been fully justified, a great many of these aerials having been built and many of them used in localities where we would have hesitated to recommend them. Although we never envisaged the design as anything more than a suburban one, we have had reports of its successful use in several favourable localities on the south coast, including one as far south as Kiama.

Its popularity has been such that the December, 1956, issue is now exhausted, even though other issues around this time are still available—a sure indication of a pronounced "run" on this issue. What is more, we are still receiving requests for this article. In the circumstances we feel justified in presenting at least an abridged version of this description, along with all the vital dimensions.

In addition we are presenting a description of a completely different type of aerial, one more suited to near fringe areas in its most elaborate form, yet capable of being made in a simplified version which would be perfectly adequate in many suburban locations.

For those who are interested in the finer points of aerial design we would refer once again to the November, 1956, issue. (At the time of writing copies of this issue are still available.) However, a brief discussion of some basic problems will help readers to appreciate the reasons for the respective designs.

Making one aerial function efficiently on a number of channels is a major problem, and one that will concern us most in this discussion. The first step is to take advantage of the fact that channels 7 and 9 operate at approximately three times the frequency of channel 2, and to design the aerial for both fundamental and third harmonic operation.

BASIC TYPE

The half-wave dipole (two quarter wave elements fed at the centre) forms the basis for virtually all TV aerials. Cut for fundamental operation on channel 2 (63 to 70 Mc) such an aerial will operate on its third harmonic in the region of channels 7 and 9 (181 to 210 Mc).

When working on its fundamental, the dipole has a field strength pattern, or polar diagram, often referred to as a "figure eight" pattern, the dipole being represented by a horizontal line running between the two loops of the "8."

In practice, this means that the aerial has equal pickup from both back and front, i.e., in a line at right angles to the dipole, but has virtually no pickup on either side. The equal pickup from both back and front can cause serious ghosting if there are any reflecting surfaces behind the aerial, and it is usual to provide at least one reflector element behind the dipole, and one or more director elements in front.

This has the effect of strengthening the front lobe and weakening the rear one until, in the case of the multi-element or "Yagi" type, an aerial results having high gain and pickup in one general direction only.

by Philip Watson

However, these characteristics are only true at the fundamental frequency for which the aerial is cut. Reverting to the simple dipole, but operating it on its third harmonic, i.e., as an aerial three half waves long, we find that the pattern has changed radically. It now has four major lobes or a "four-leaf clover" pattern, with each lobe lying roughly 40 degrees to the line of reception established for the fundamental.

Signal pickup in a line at right angles is very poor.

REFLECTIONS HELP

Reflectors can attenuate the two rear lobes, but the two front lobes, both pointing in the wrong direction, still have to be dealt with. If not, there would be little direct pickup and a lot of reflected signal pickup, with disastrous results to the picture.

It is the conversion of these two angled lobes to a single "in line" lobe that constitutes the major problem to be tackled in designing any aerial for both fundamental and harmonic operation.

In the case of the fan, we do it very simply by angling the elements forward about 35 degrees, this having the effect

f pushing the two lobes together to form ne broad lobe. At the same time, the ear lobes tend to come forward also, cing now at about 90 degrees to the ne of reception. There is also a minor ear lobe.

The result is an aerial having a ajor lobe to the front, a minimum or null" point at about 45 degrees either ide of the reception line, and smaller obes at 90 and 180 degrees. The exact ize of these lobes will vary with the umber and disposition of reflectors (if ny) but can generally be made small nough for average conditions with one ach high and low band reflector.

Another basic problem concerns the andwidth of the aerial. Because of the xtreme bandwidth of a TV signal — early 7 MC in our case—it is quite easy o make an aerial which is excessively harp, possibly prejudicing the final video esponse. Of almost equal importance s the fact that a broad aerial will ac ommodate many of the compromises ecessary to make one aerial cover a umber of channels.

LARGER ELEMENTS

In general, making the elements arger in diameter relative to their length owers the "Q" and increases the band- vidth. In practice it is not necessary ctually to increase the size of the lements, and simply providing more lements in "parallel" produces much he same effect. This is how we arrive t the design of the fan, the splayed isposition of two or more elements in lace of each section of the dipole being he result.

The other generally accepted method f increasing the bandwith is to extend he simple dipole into a folded dipole, he folded dipole being the basic element n the large majority of TV aerials. This rrangement has the effect of raising the entre impedance (72 ohms in the case f a simple dipole) to something more anagable and nearer the characteristic mpedance of practical feeder lines.

Reverting to the polar diagram of the an, the null at 45 degrees can often e put to good use where a single object s causing a ghost. This was effectively emonstrated at our workshop locality n the city, where the Harbour Bridge s to one side of our line of reception, nd produces a troublesome ghost.

ORIENTATION

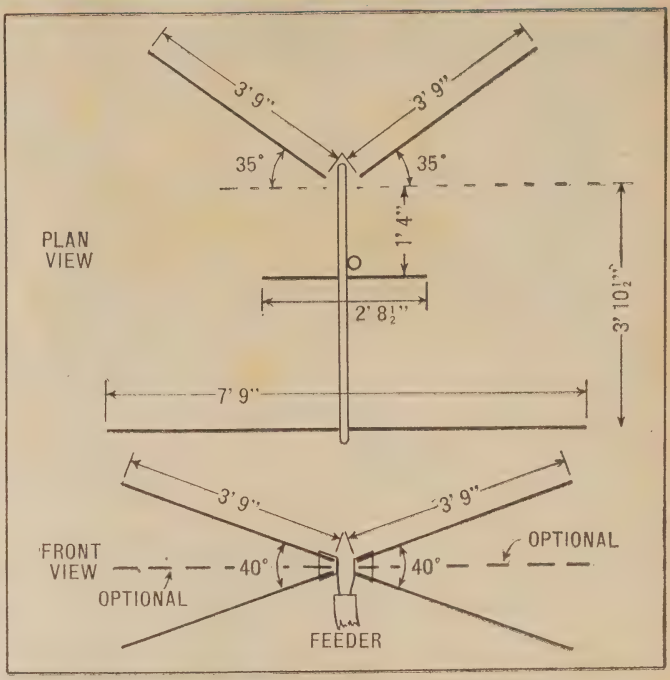
Although at something less than 45 legrees, the broad main lobe allowed considerable latitude of orientation without significant loss of signal, permitting the null to be lined up accurately on the Bridge. In this respect the orientation is quite critical. This was a case where the fan won "hands down" over other types with different field strength patterns.

On the other hand, where the reflecting object is at right angles the fan is less useful, and other types would have to be considered.

Other queries we have had about the fan concern the presence of the high band reflector and the use of only four main elements instead of six, since both these arrangements appear contrary to commercial practice.

While we were making field strength measurements for the new aerial yet to be described, we took the opportunity of

DIMENSIONS OF FAN TYPE AERIAL

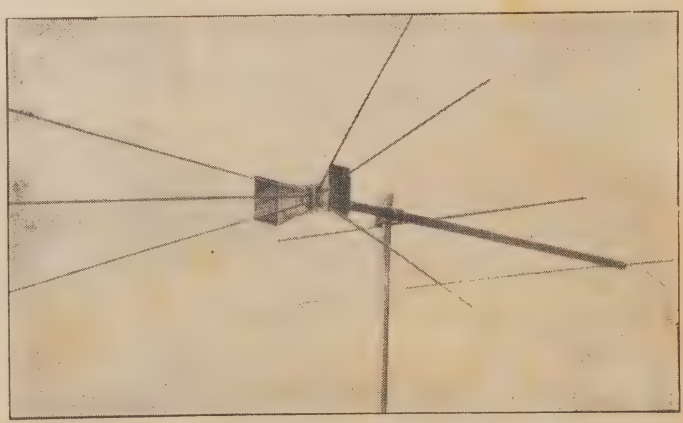


This diagram shows the essential dimensions of the fan-type aerial. The two reflectors can attach directly to the metal boom but the two main sections of the dipole must be insulated one from the other and from the boom.

checking these points on the fan. It is true that the reflector is not essential, but we found that its presence did make a measurable difference to the forward gain and, consequently, to the back-to-front ratio on channels 7 and 9.

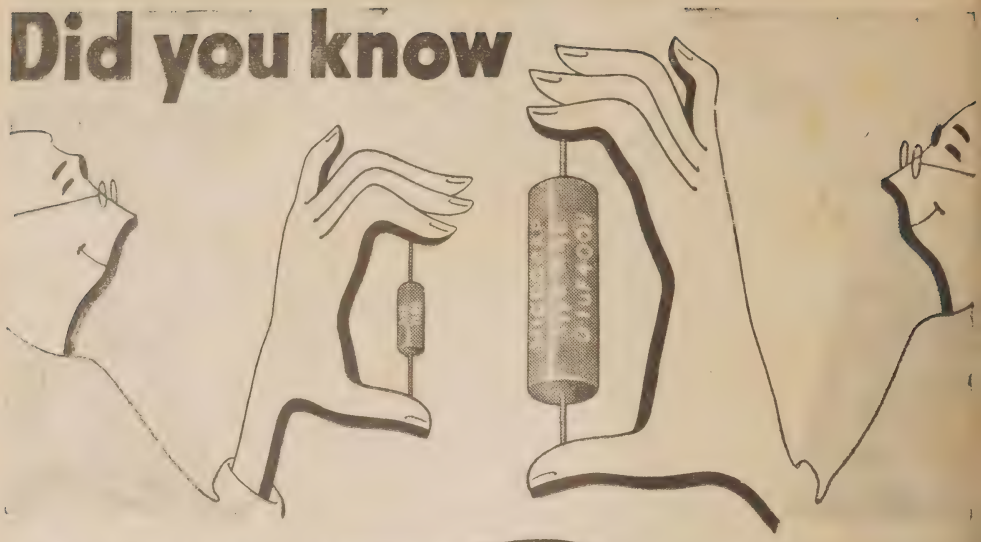
Although not staggering, it would appear to be worthwhile if only because the reflector is so simple to fit, at virtually no cost, and without adding in any way to the complexity of the aerial. In short, something for nothing.

Adding the two centre elements (shown dotted in the diagram) also improved the gain slightly, but again it was nothing staggering. Since the fitting of these two elements is a bigger job, in-



This photograph shows the complete fan-type aerial, with six radial elements and both low and high band reflectors. The centre radials and the high band reflector can be regarded as optional, as explained in the text.

Did you know



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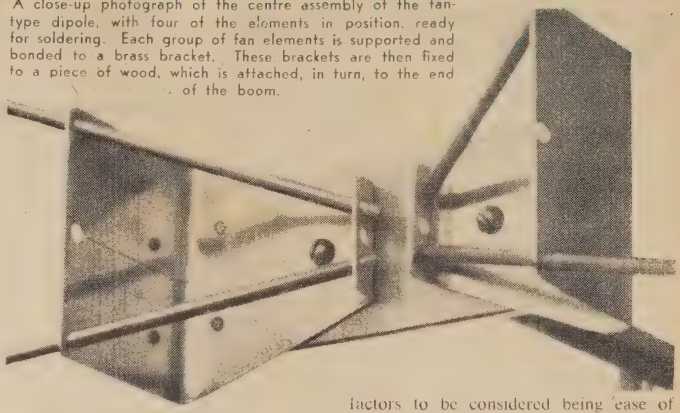
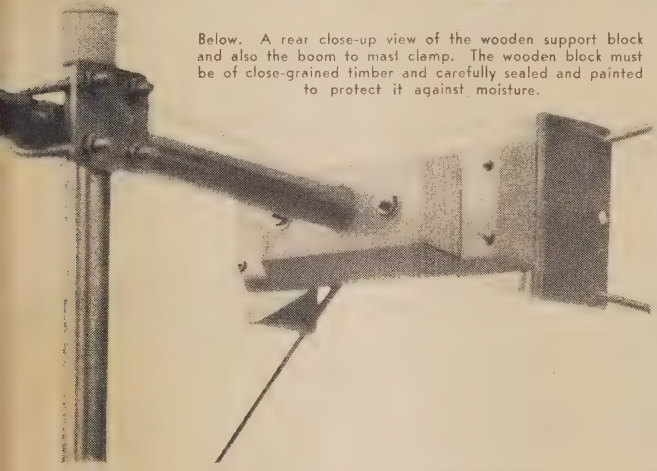
lving a fair amount of material, their
lue is rather more doubtful.
In short, we feel that the original de-
n is still good compromise, but there
no objection to fitting the extra ele-
nts if you feel like it.
We also took the opportunity to com-
re the fan with a completely different
pe of commercial aerial, though one
viously designed to do much the same
, i.e., provide satisfactory operation
suburban and outer suburban areas
ere there are no acute reflection prob-
ns.
Although physically more complex,
nsisting of both high and low band di-
les, plus directors and reflectors, our
easurements showed it to have some-
at less gain and a poorer back-to-front
io. However, it did have better re-
tion at 90 degrees, and this could be
ry important in particular cases.
All of which should serve to put the
n in its proper perspective. We have
reason to modify our original claims
r it (except, perhaps, that they may

CLOSE-UP OF ELEMENT SUPPORT

A close-up photograph of the centre assembly of the fan-type dipole, with four of the elements in position, ready for soldering. Each group of fan elements is supported and bonded to a brass bracket. These brackets are then fixed to a piece of wood, which is attached, in turn, to the end of the boom.





Below. A rear close-up view of the wooden support block and also the boom to mast clamp. The wooden block must be of close-grained timber and carefully sealed and painted to protect it against moisture.

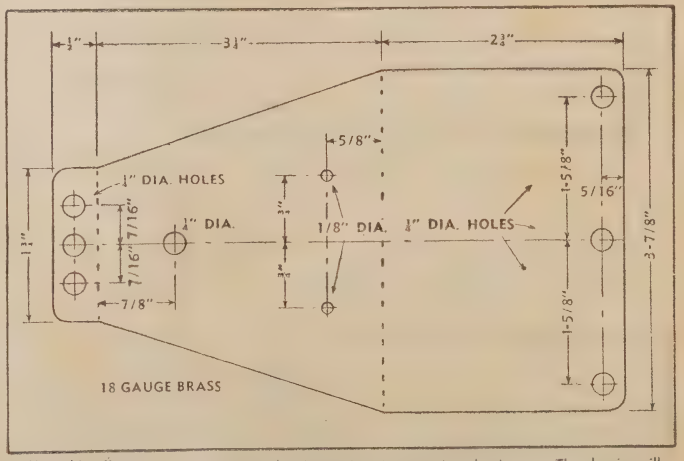
ve been a little conservative) and we
ll consider it an excellent design in
alities which are obviously free from
ltiple reflection problems and have at
st a moderate signal level available.
Coming to the practical side, we may
nsider a few points about the actual
nstruction of the fan. All the essential
mensions are shown in the accompany
g diagrams, leaving mainly the
terials and assembly procedures to be
nsidered.
First the materials. This subject has
ompted a great many questions from
ospective builders; mainly along the
es of the relative merits, in the elec-
cal sense, of the various metals —
ass, steel, aluminium, copper, etc. —
ely to be used for the elements. There
ve also been some doubts expressed
out the effectiveness of the wooden
ulator block used in the centre of
e elements.
In regard to the element materials, we
uld like to emphasise that no one
tal has any magical properties which
ke it any more desirable, from a per-
rmance point of view, than any other
hatever you care to use will work
t as well as the original, the only

factors to be considered being ease of working and ability to withstand the ravages of wind and rain.

Nor is the diameter of the elements of any practical significance. It is true that this dimension does have an effect, at least in theory, but it is quite negligible for any normal sizes of material. The lengths of the elements, the spacing between them, and the angles shown in the diagram are the critical points. Stick to these and you will have no worries.

Physically, three types of material suggest themselves: Brass, aluminium (or one of the associated alloys), and copper-clad steel, known as "bundy tubing." Tubing is specified in all cases, not for any electrical reason, but simply because it is lighter for a given size. You may try solid rod if you like, but it will probably present some serious support problems, as well as a hazard if it fell on anybody!

Brass has the advantage of being easy to work, including soldering, and does not readily corrode. It may be plated or painted before erection, but this is not essential. Aluminium is light, and



Use this diagram to mark out the brass brackets pictured above. The brass will tarnish after exposure to the weather, but electrical efficiency will not suffer. It can alternatively be painted, if desired.

THE WARBURTON FRANKI PAGE

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The W.F. 3-valve Amplifier sells at £16/19/6. freight fwd.
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CHASSIS—Aluminium Blanks

		POST VIC.	INT
3in x 3in x 2in	7/9	9d	9d
6in x 4in x 2in	8/9	1/	1/
8in x 5in x 2½in	11/	1/	1/
10in x 6in x 2½in	13/3	1/3	1/3
11in x 8in x 2½in	16/	1/6	1/6
13in x 7in x 2½in	16/	1/6	1/6
15in x 10in x 2½in	19/3	1/6	3
17in x 8in x 3in	24/3	1/6	3/-
17in x 10in x 3in	26/5	1/8	3/8
17in x 12in x 3in	28/8	1/8	3/8

Steel punched chassis as used for W.F. 3-valve Amplifier 8in x 5in x 2½in 19/10. Post: Vic., 1/8; Int., 3/8

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12in Square type. 46/3. Post: Vic., 2/3; Int., 3/8.
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Plastic Covered. 8in. 54/11. Post: Vic., 1/3; Int., 1/3.
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0-1mA (plain or multimeter scale). 95/ plus 12½ per cent S.T. Post 1/6
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3/4in 23/4	35/
1in 30/	51/3
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Overall Diameter	5¼in	6½in	8 3/16in	12¼in
Baffle Opening	4 13/16in	5 9/16in	7 1/8in	11in
Voice Coil Diameter	¾in	1in	1in	1in
Voice Coil Impedance	2.7 ohms	2.7 ohms	2.7 ohms	2.7 ohms
Cone Resonance Frequency	130-C.P.S.	45-C.P.S.	45-C.P.S.	45-C.P.S.
Range	130-10K	30-15K	30-15K	40-15K
Power Handling Capacity	4 Watts	6 Watts	7 Watts	10 Watts
Retail Price	55/11	£6 10/-	£7	£7.9.7
Post: Vic.	1/10	1/10	2/3	2/11
Post: Int.	3/-	3/-	3/8	4/4

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asy to work, except for the virtual im-ossibility of soldering it. It tends to orrode very rapidly at first, but the oating of oxide so formed is in itself protection and nothing more is nor-nally needed.

Bundy tubing is cheaper, is not quite o easy to work, but may be soldered f reasonable care is employed. Although he copper plating is intended to pro-ect the steel, any break in this coating vill allow rust to commence and event-ually find its way under other parts of he copper. It is quite suitable for under-the-roof" aerials but will need to ave the ends of the tube carefully ealed and the whole well painted if it s to be used out of doors.

TWO SECTIONS

Except in the case of aluminium, it eems preferable to make the longer ele-nents in two sections, roughly equal in ength, but of different diameter tubing. By using the heavier tubing for the nner section only, the weight is re-luced at the ends of the element without ny sacrifice in strength where it is most eeded.

We used ¼in diameter, 22 gauge brass ube for the heavier section, and this ..uge provides a nice slide fit for 3/16 iameter tubing. The gauge of the latter s not so important, but 22 or 24 would e suitable. For the boom we suggest -8in or 1in by 22 gauge tubing, and ou will require at least 4ft 6in.

The wood used for the insulating block nay be any reasonably close grained imber. Hardwood is excellent if it is ell seasoned, but should be avoided in he green state before its shape and size ave stabilised. In any case, it should e given a coat of paint to preserve it.

Fortunately, the insulating properties o not need to be particularly good at his point in the system, since the im-edance is only of the order of 300 ohms nd it is unlikely that even the poorest uality timber would have anything like s low a value as this, in any circum-tances.

The second aerial we have to describe s the result of our desire to produce omething better than the fan, particu-rly in terms of directivity, for those reas where multiple reflections are nore serious. It is not in any sense a eep fringe area type, its gain being nly a little better than the fan, but it as a much better back-to-front ratio, lus an almost complete null at 90 de-rees. We imagine it should be just the hing for those localities where a fan s not quite good enough.

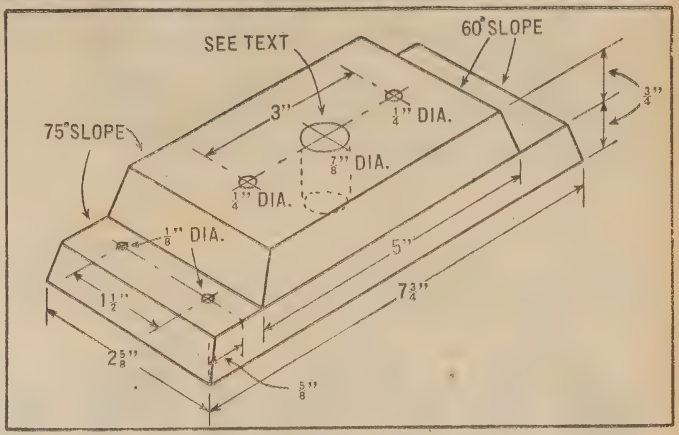
VERSATILE

The basic design is also a very ver-atile one. It makes possible an extreme-y simple aerial for those localities where o serious problems exist, yet one which nay be built up to a quite complex unit vhere ghosting problems justify it.

We arrived at this design the hard way Having studied the equivalent designs in verseas technical journals, we converted he dimensions to suit the local con-itions, "mocked up" a version in easily djustable form, and then proceeded to onduct a series of lengthy field-strength neasurements to confirm that we were n the right track.

The equipment we used for this was ecessarily simple and the readings more omparative than absolute, yet they did ndicate the order of performance quite ccurately. In fact, the patterns we ob-ained showed a remarkable resemblance

SUGGESTED SHAPE FOR WOOD BLOCK



A suggested shape for the wooden block which supports the two dipole sections. The actual shape has no electrical significance and may be varied if desired. The block could alternatively be fashioned from other suitable insulating material.

to the theoretical patterns in published texts.

All this, of course, meant a lot of work. Apart from finding a suitable site, free from obvious reflections, we had to erect each tentative design, set it to various angles, and note the reading on a field strength meter. Then, having plotted a pattern, we had to check that what was right on one channel, had not produced some silly effect on the other channels. As it turned out, this "practical" approach proved to be completely justified.

This design starts with a folded dipole, cut approximately as a half-wave for channel 2, but more correctly as three half-waves at 193 Mc.; a compromise figure actually within channel 8, but intended to encompass both 7 and 9. After allowing for end effect, this gives a fundamental frequency of 62.5 Mc., a little on the low side of channel 2, but perfectly satisfactory in practice.

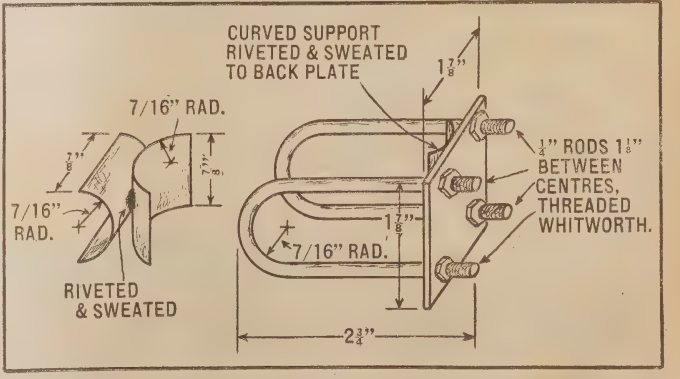
As before, this will have a figure eight pattern on Channel 2 and a four-leaf clover pattern on 7 and 9. The method of converting the later to a figure eight pattern again is quite ingenious and, judging from overseas literature, very popular in the U.S.A., where it is produced commercially in several slightly different versions. This trend is also being followed by several Australian manufacturers.

The scheme is based on reversing the phase of signal currents in the centre section of the dipole. In its natural stat the dipole operating on the third har monic is equivalent to three half wave in series. The two outer sections are i phase with each other, but the centre section is 180 degrees out of phase with these two. It is this out-of-phase section which splits the single lobe into the two lobes at 40 degrees.

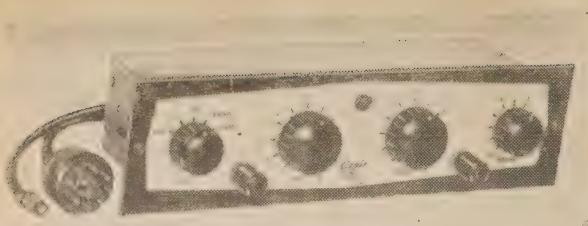
PHASE REVERSAL

If we can reverse the phase of the centre section we will have three half waves in phase, a combination which functions very much like three separate half-wave aerials side by side. This not only restores the figure eight pattern but actually narrows the two lobes appreciably.

Fortunately, this phase reversal is not hard to achieve. A simple phase reversing element, cut to one half wavelength at the harmonic frequency and mounted directly in front of the dipole is all that is required. No connection needs to



Details of the U-bolts, clamp plate and socket which lock the boom to the mast. Dimensions will have to be altered if a thicker boom or mast is to be used.



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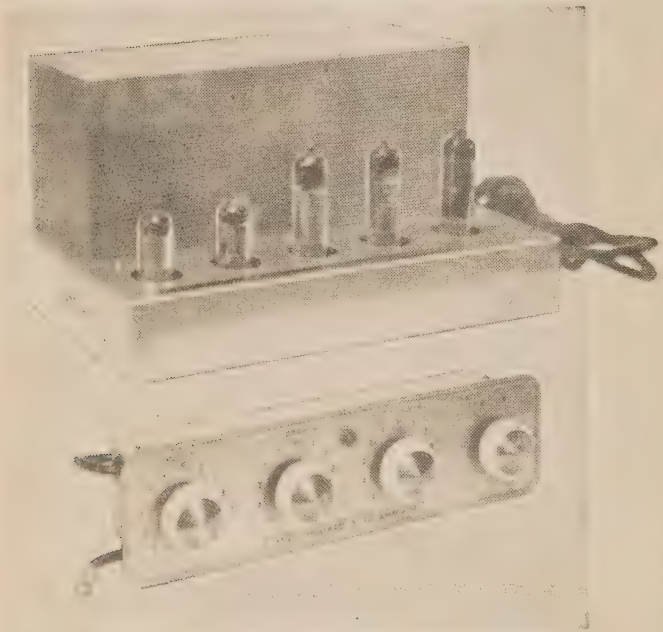

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made to it, nor does it need to be ilated from the boom.

Simple though the scheme is, it is npletely effective. Field strength pat-ns we made with the folded dipole ne showed the four-leaf clover pat-n quite clearly but, immediately we ed the phasing element, the pattern erted to the figure eight. What is re, there is a definite gain in the ward direction, giving a useful initial k-to-front ratio.

Such an aerial represents about the plest practical multi-band aerial it possible to imagine. Admittedly, the k-to-front ratio is small, but there are nty of localities where it would be quate. The important point is that right-angle directivity pattern holds all channels.

FLECTORS AND DIRECTORS

From here the natural step is the ad-on of reflectors and directors to im-ve the back-to-front ratio, and this is manner in which the areial is built into its final form.

For channel 2 a single reflector l probably suffice in most cases, and s is a single element, 7ft 9in long, ced 33in from the dipole. It would be sible to add a director also, should s seem necessary, and we will have re to say about this later on.

Single reflectors and directors for the her bands may also be added, and y be all that is required in some es. However, where necessary, a re elaborate system can be employ-which is significantly better. This vides a reflector or director for each f wave section of the folded dipole, king three sections in all, mounted l to end but insulated from one ther.

In its final form, our aerial is fitted h one set of three such reflectors, d one set of three directors. How-r, it would be possible to add more ments, particularly directors, if this uld seem to be necessary.

In the case of the fan the reflector s a compromise length. In this case cut and spaced the reflectors to our channel 7, with the idea of cut-g the directors to favour channel 9 is idea worked out quite well as far the reflectors were concerned, but we struck some peculiar effects when we fitted the directors

With directors cut for channel 9 (approximately 28in) the aerial suddenly lost all the excellent characteristics it had exhibited thus far and turned almost completely back-to-front on the two higher bands

By the process of cut and try we finally arrive at a dimension of 20in for these directors which appears to be about optimum. This gives an excellent performance on both high bands, with virtually identical field strength patterns.

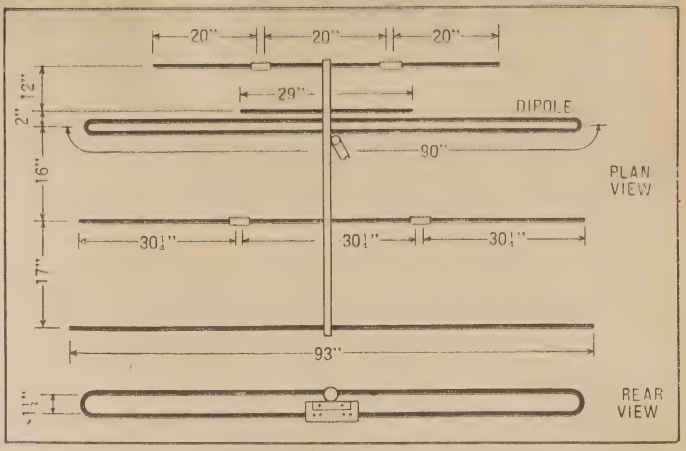
Although the final result is an extremely good aerial it is as well to keep in mind that it need not be built up to this final form unless absolutely necessary. In fact, the thing which appeals to us most about this aerial is its versatility, and we think the various versions are worth summarising.

Stage one is just a folded dipole and phasing element; a simple but perfectly satisfactory aerial for use in "easy" locations. Stage two is the addition of a single director and/or reflector for the high band and, should it appear to be necessary, a low band reflector as well. Finally, the high band reflector and director may be built up into multiple units, bringing it to the stage to which we finally developed it.

It is even possible to carry these ideas several stages further, although we have not actually tried this ourselves. For those who may be interested we suggest the following: A second set of high band directors may be added, having the same dimensions as the originals, and spaced some 14 inches in front of them.

Alternatively, a low band director could be added. This would be approximately 5 per cent shorter than a dipole cut for the centre of channel 2 (say 66.5 Mc.). This works out at 81in. It would need to be spaced at least as far away as the reflector (33in) and preferably one quarter wave length (46.5in). Main objection to the latter idea is the long boom required.

DETAILS OF TV MULTI-BAND BEAM



This diagram shows the plan view and the rear elevation of a multi-band beam type aerial. As mentioned in the article, elements can be subtracted from or added to this array to obtain the desired order of performance.

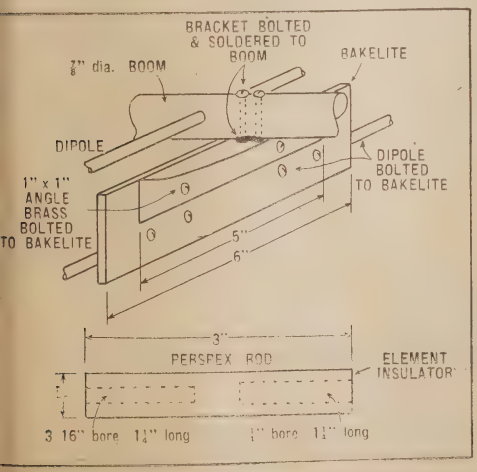
BOTH TOGETHER

Combining these two ideas may call for some further investigation, but there is no reason why you should not try it if you care to. The main risk is that the low band director may upset the operation of the high band directors if grouped too closely together. However, if the full low band quarter wave spacing was adopted there would probably be adequate clearance.

(Some commercial aerials of this type have the low band director placed between the two sets of high band directors.)

Fairly obviously, a longer section of tubing for the boom should be purchased if such additions are contemplated.

Coming to the practical side, there are a number of minor points to be considered. The remarks already made about materials apply equally to this aerial, but we imagine that the choice will narrow down to brass or aluminium. In the latter case a larger diameter tubing, and heavier gauge would be in



☆

A detail drawing of the angle bracket and insulating strip which supports the active ends of the folded dipole. The exact type of insulation is not critical, provided it is weather-resistant and able to support the dipole elements. The feeder connects one lead to each end of the dipole.

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er. We suggest ½in diameter by 18 16 gauge, and this may be used oughout, without the need for lighter s at the element extremities.

ince soldering is not really feasible, rnative mounting methods will have be employed, based on the use of s and bolts and, where necessary, all brackets. We have not had an portunity to fully investigate this terial and the problems associated h it, but we imagine that these would present any serious obstacles to the rage enthusiast.

We made our aerial from brass, inly because the use of two differ- diameter tubes, sliding one within other, provides a very convenient ans of adjusting element lengths on experimental basis. It is only neces- y to crimp the ends of the larger e slightly in order to produce a firm ling fit. In this way virtually any nbination of element lengths can be ained in a few minutes.

OLDERED JOINTS

Fairly obviously, when the aerial is be made permanent, all these joins l have to be soldered. By careful liminary tinning of the surfaces in- ved a soldered joint several inches g may be formed inside the larger e, making a very strong joint.

The centre section of the channel 2 re- ctor and the two centre portions of dipole are made from three lengths ¼in tubing approximately 4ft long. e of the dipole sections is cut ap- oximately 1in shorter than its neigh- ar, then halv d, the two portions thus oduced forming the lower or "feed" tion of the dipole. They are spaced proximately 1in apart at the feed nt, although this dimension is by no ans critical electrically.

With the exception of these two sec- ns, which we will discuss in greater ail in a moment, all the elements are tened to the boom by being passed ough it and soldered into place. All remaining centre elements — the asing element and the director and lector—are also made from ¼in tubing. Drilling a series of holes through the om which will ultimately line up curately in both the vertical and hori- ntal planes may seem like a tough ignment with ordinary workshop tools, a few simple tricks will assist terially.

First make a loop of string passing ough the inside of the tube and along outside. Tie it as tightly as possible d line it up visually so that it runs aight along the outside of the tube. is will then serve as a guide to enable various hole positions to be centre- nched.

PPOSITE SIDE

Do not drill any holes at this stage t transfer the loop to the opposite side the tube and repeat the centre-punch- . The first marks are most easily nsferred by wrapping a piece of aight-edged paper around the tube. ill all holes from the outside of the e rather than by drilling straight ough from one side.

The holes should be first drilled to ly 3-16th inch and a piece of this size ing pushed through them. This will able the accuracy of the drilling to be ecked, and the holes may then be en- ged to ¼in with a rat-tail file, at the ne time bringing about any minor cor- tions that may be necessary.

The two shorter sections of the dipole need to be supported on an insulator to provide the feed point of the system. Many ideas will suggest themselves, and the humble wood block would be just as suitable here as in the fan. However, we chose a slightly different arrangement which should serve as a guide at least.

We made a small bracket from a piece of 1in x 1in angle brass and bolted it to the boom slightly backward of the point where the dipole element passes through it. After lining it up carefully, both vertically and horizontally, we then soldered it to the boom on each side, using plenty of solder, flux and heat to ensure a secure joint. Surplus flux is cleaned off with methylated spirit.

The insulator was made from a piece of ¼in thick black bakelite, though a thicker piece may be preferable. It should certainly not be thinner. Note that the thickness of this material will govern the exact position the angle bracket should occupy to permit the upper and lower sections of the dipole to line up.

The insulator is fastened to the bracket with brass nuts and bolts, using extra lock nuts or a dab of lacquer to ensure a permanent job. The end of each element is drilled with two ¼in holes, about 2in apart, with corresponding holes in the insulator. The ¼in bolts used here should be long enough to permit an extra set of nuts and brass washers to be fitted after the main assembly, to provide the terminal points for the feed line.

The two outer sections of the dipole are made from 3-16in tubing, approximately 4ft long, and each has to be bent into a U shape about its centre point. The size of the bend is not critical in the electrical sense, but it will affect the mounting position of the two shorter elements on the insulator. In our case, the tube was bent around a 1½in mandrel, and this is a very convenient size.

BENDING TECHNIQUE

It may be possible to bend this tubing cold, but we don't recommend it. It will probably flatten, and may even fracture, as well as being physically difficult. We suggest heating it with a blow-lamp, gas flame or primus, then wrapping it quickly around a suitable mandrel already set up in a vyce. This may be a piece of water pipe, metal rod, or even a humble food tin if you can find one the right size. Wood could probably also be used, provided a slight charring is no objection.

Only a moderate heat is required, and the red-hot condition is best avoided. Try to apply the heat as evenly as possible over about six or eight inches and for just long enough to make it soft. It may be held on each side of the flame with a piece of cloth and transferred rapidly to the mandrel at the appropriate time.

The insulators to support the outer director and reflector elements must also be considered. These need to be strong enough to support the element, as well as withstand the stresses of the wind. At the same time they need to have good insulating properties and to retain these under all weather conditions. The insulation requirements here are much more exacting than at the centre of the dipole, since the impedance is quite high at this point.

After discussing the problem with various suppliers we concluded that Perspex would be the best material. We hoped to obtain it in tube form with a 3-16in bore to suit the smaller elements, which would not be too difficult to enlarge to ¼in for the larger ones. Unfortunately this form is extremely scarce and we had to settle for rod and arrange to have the necessary drilling done in a lathe.

The rod we used was ¼in diameter, and each insulator is approximately 3in long. Four insulators are required, and it should be possible to make these from a 1ft length of material, even allowing some waste in cutting. Since this rod is worth something like 5/ per ft and is normally only sold in multiples of one foot, one has to decide whether to buy the exact amount or an extra foot in case of accidents.

It should not be hard to find someone to do the drilling for a small fee, but they will need to have had a little previous experience in handling Perspex or similar plastics. In the event that larger diameter aluminium tubing is used a proportionally larger diameter rod will be required and the drilling modified to suit. Details of the insulator we used are given in the accompanying drawing.

SECURING THE ELEMENTS

If the insulators are accurately drilled, the elements will probably be a tight push fit into them and should need nothing extra to hold them. Failing this we suggest that a fine hole be drilled through the insulator and tubing, through which a piece of copper wire may be passed and twisted into a half loop around the insulator.

To fasten the boom to the mast we suggest a fitting similar to that originally specified for the fan, which is illustrated in the accompanying drawing. Alternatively, it may be possible to find a water pipe "T" fitting which may be filed to a slide fit over the boom, and which can then be screwed to the top of the mast. The only objection to this arrangement is that it has to be fitted before the two rear sets of elements.

Which just about covers most of the constructional problems likely to be encountered in building an aerial based on this design. We think you will find it a most useful one, whether in its simplest form, or built up to or beyond our final design.

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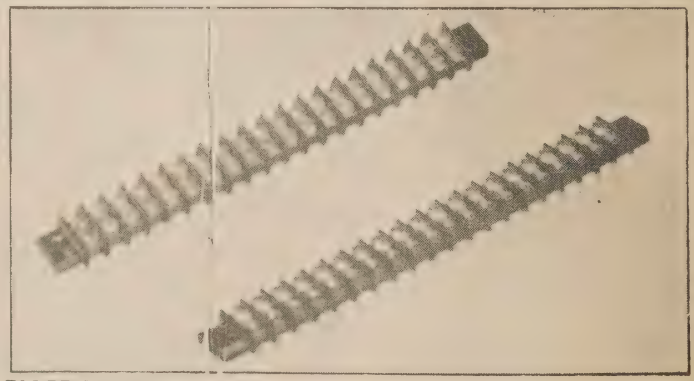

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TRADE REVIEWS AND RELEASES

UAL CHANGER VAILABLE WITH TEREO PICKUP

The Dual model 1004S, one of the most popular changers on the market, is now available with a stereo pick-up head. A sample tested recently proved just as successful as the single-channel version. The head is known as KS2 and the sapphire stylus assembly DN3.

HE 1004S is a fully automatic changer with some interesting features. One these is the ingenious method of plac the stylus in the first record grooves. When the Start button is pressed, the m moves over to the centre of the ord, and then drops to the surface. At this point, a smooth roller only ches the disc, and the arm then moves toward the rim with the roller in tact all the way.

As soon as the edge is reached, the er drops off the disc, and this action cks its outward movement.

The arm rests on a guard for a second l then the head is gently lowered so t the stylus engages the groove.

At the completion of the record, ether the player is adjusted for nger or single play, the arm returns its stand, and is locked into place the power is switched off. This is a y useful feature as it prevents the n from being accidentally damaged by vement, or the mechanism strained by attempt to use the arm when the de e is not working.

It plays all four speeds, and the nger will accommodate mixed record es.

The stereo head rocks to and fro to nge stylus from 78 to L.P.-Stereo as armature carries both stylus tips.

The stereo stylus diameter is given as 06 inches, slightly larger than the ndard, but not as large as the 7 mill e. It is to be used for ordinary L.P cs as well.

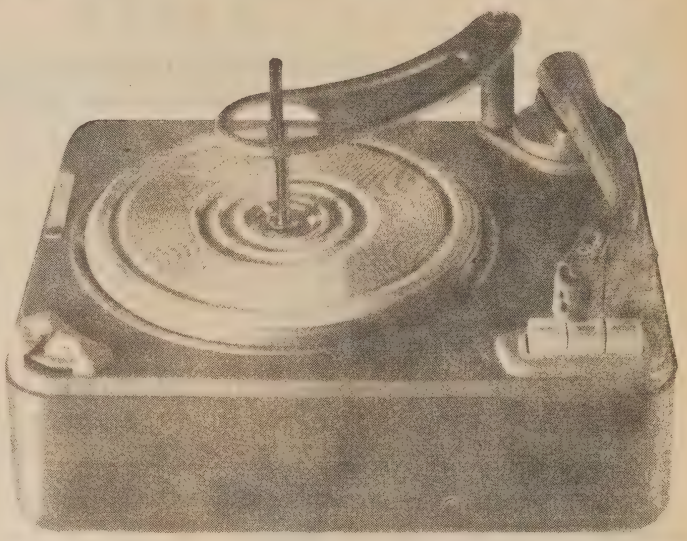
There is a switch on the motor board ich parallels each section of the stereo k-up for single channel operation.

On test the changer behaved very well e stereo pick-up on listening check mpares favourably with any of the stal types so far released here, al ough no test discs are yet available. paration was ample and output good. In the stereo position there is an in ase in motor rumble as against the gle channel, but this is not really serious when played through an amplifier at good room volume. Some rumble on stereo is difficult to avoid except with motors of the highest transcription class.

No acoustic feedback was experienced, but with a stylus pressure of 5 grams, one must not jitterbug near the turntable. The stylus pressure seemed a little light for 78 records.

A number of standard L.P. records of recent origin were played on the changer, and the fine stylus gave no trouble, nor was the surface noise unduly high.

The new dual changer is the first stereo type to be submitted for test, and its performance indicates a good quality, practical design.



The Dual Model 1004S Stereo Changer.

GOODMANS 400 LOUD SPEAKER RELEASED

High sensitivity, wide response, and greater smoothness are features of two new Goodmans loudspeakers recently released here. Both are twin-cone types of improved design.

FOR many years, the Goodmans twin-cone Axiom 150 and 22 series of loudspeakers have been widely used and approved for their fine performance.

Goodmans were a pioneer in developing the twin-cone principle, in which a small inner high frequency cone is fastened to the voice coil which already drives a larger cone for low and middle frequencies.

It represented a simple and economical method of achieving wide-range response from a single cone assembly.

Two new models have now been released, the 300 and 400, to replace the 150 and the 22.

In general terms they are similar, but modifications have improved results still further.

The large cone is now impregnated at the periphery and for some distance toward the centre to improve suspension characteristics and reduce standing wave effects.

The smaller, inner cone now carries damping pads of sponge material again to supply better damping at high frequencies.

Tested in a large enclosure, the type 400 proved to be a very good speaker indeed. It handles a high degree of power, and its main cone resonance is almost damped out.

There is still some rise in output in the vicinity of 8 Kc, which apparently is characteristic of this design, but the high frequency response is noticeably smoother than with the old model.

Sensitivity and transient response of the 400 are both very good. Our test speaker was submitted by United Radio Distributors, of Phillip St., Sydney, who can supply further details of these and other Goodmans speakers.

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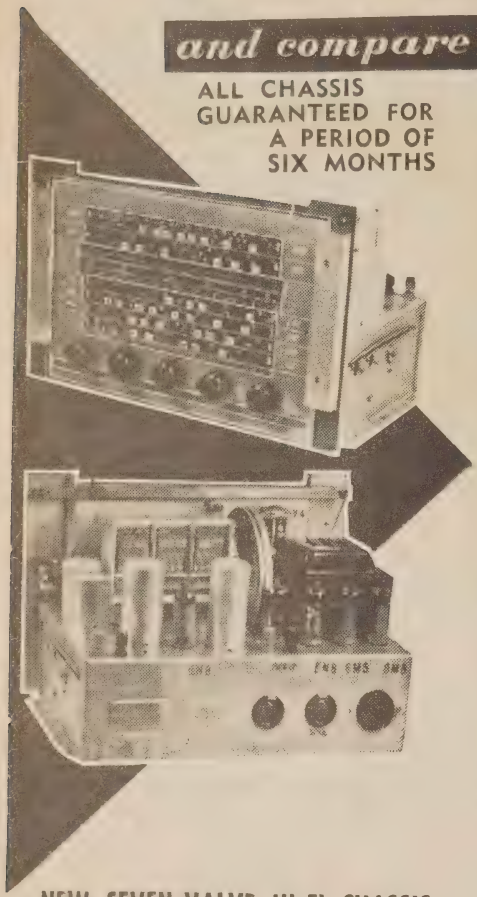

NEW:

Ultramodern circuit using nine high gain valves including "magic eye" tu indicator. Permatuned iron cored coils and intermediates giving excellent l state reception and a short wave range of 12,000 miles. All valves used the new Mullard nine pin Innoval series.

NEW:

Ton control and audio stages incorporating the Mullard 5/10 amplifier ci with separate bass and treble controls giving plus or minus 15 db boost or at 50 cycles L.F. and 10,000 H.F., combined with push-pull output with in feed-back gives you really high fidelity reproduction from your radio or favo recordings.

NEW:

Dual Speaker combination, using a heavy duty woofer (12in M.S.P. Jensen A special) with matching 6in tweeter and cross-over network giving a frequ response of 46 to 13,000 cycles. Speakers are mounted coaxially making one 11in mounting hole necessary.

NEW:

If required the new Magnavox high-fidelity twin coned speaker can be supp Large calibrated edge-lit dial in plate glass (11in x 7in) with main station each State in prominent type. Dial fitted with counterweight drive, giving sm tuning. Indicator lights are fitted showing which band is in operation. can be supplied in cream, black or brown with matching knobs and escutc to suit contemporary blond or walnut finished cabinets.

NEW:

Sensitive "magic eye" tuning indicator (EM80) making tuning simple and pos even on interstate, overseas and country stations.
All chassis are wired for the fitting of F.M. tuner or tape recorder, sp plug being provided on back of chassis, also pick-up terminals and outlet gramo motor.
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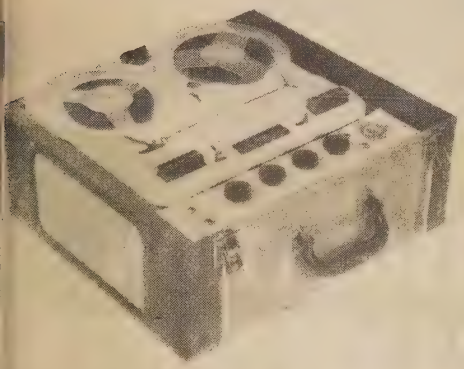

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he six-valve amplifier incorporates the latest "Mullard" pe recorder circuit equalised to C.C.R. standards giving rfect reproduction from recorded tapes. Record monitor- g and outlet to power amplifier. Extension speaker out- t and "magic eye" level indicator. Amplifier is com etely shielded and fitted with perspex dress plate to match ck.

- **HIGH FIDELITY**
  Heads are double coil wound and will reproduce up to 12,000 c.p.s. at 7½ inches per second. Azimuth adjustments on both impedance "record" and "playback" heads. Output of heads is approximately 5 milli-volts at 1 Kc at 7½ inches per second.
- **INSTANTLY REVERSIBLE**
  Instantaneous changes can be made from one track to the other. Fast rewind in either direction
- **CONSTANT TAPE TENSION**
  A special Collaro device ensures a constant tension on the tape on the take-up spool as it leaves the capstan.
- **FULLY MECHANICAL**
  No solenoids are used in the construction of this Transcriptor. The braking is entirely mechanical
- **FINISH**
  Cream Polystrene cover plate with maroon controls.
- **THREE SPEEDS**
  3¾ 7½ and 15 inches per second
- **FOUR HEADS**
  Two "Record/Play-back" and two "Erase" heads are sited on two different levels and head wear thus halves for any given length of track.
- **TWIN TRACK OPERATION**
  One pair of heads for each track. Both top and bottom tracks can be recorded or played back without removing tape.
- **PAUSE CONTROL**
  This has the effect of stopping the transit of the tape past the "Record/Play-back" and "Erase" heads and applying the brakes to the spools while leaving all switches and mechanical functions in their selected positions. Typical application is to pause whilst recording to omit speech interposed between musical selections. Control will only work whilst it is held in position.
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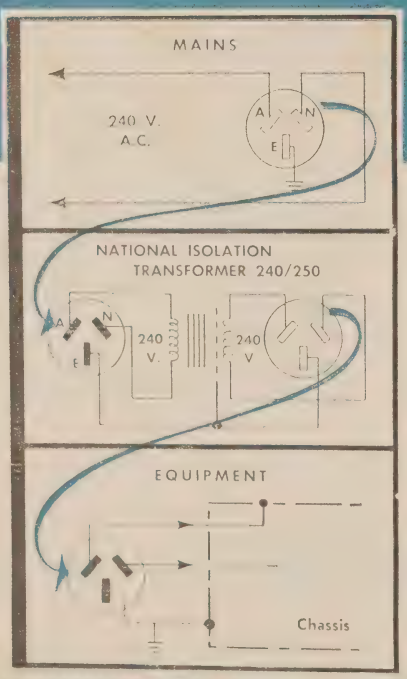

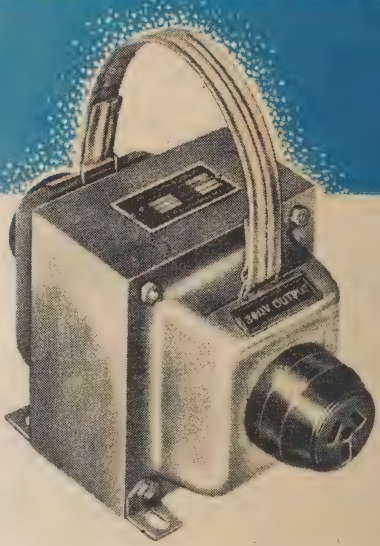

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NEW BOOKS

OR TAPE USERS

MAGNETIC TAPE RECORDING by G. M. Spratt. B.Sc. (Eng.). M.I.E.E., blished by Heywood and Company d., London 1958. Hard cover, 319 ges. 9in by 5½in. illustrated by line awings, photographs and circuit grams.

The increasing importance of tape re rding for both entertainment and in strial applications is reflected by the mber of books at all levels which ve appeared on the subject in recent nths.

"Magnetic Tape Recording" begins h a fundamental treatment of the nciples of magnetism and properties practical magnetic materials, goes on treat the principles of magnetic re ding, the manufacture of tape with a cussion of materials used including nufacture of basic iron oxides. The ok reviews commercial recorders and tating machines, testing of machines l the application of magnetic record . Circuits of parts of recording ampli s appear but it is assumed that the der is more interested in the mag ic and mechanical design than the ctronic circuitry.

A book for the electronic engineer o wishes to gain a specialised know ge of tape recording.

Our copy from the Technical Book l Magazine Co., 295 Swanston Street, lbourne. The price is 79/3 plus 3/- tage. (M.V.F.)

OR BEGINNERS

WIRELESS FOR BEGINNERS. by L. Boltz, B.Sc. (Hons). London, pub ed by George G. Harrap and Co., ndon. Hard cover, 272 pages. 7½in 5in. illustrated by line drawings, cir s and photographs.

This really is a beginner's book. It ts right at the beginning, with a pter devoted to naming and describ the various parts of a radio receiver. s is followed by chapters on elec ity, magnetism and simple AC ory; the latter being logically de oped into the theory of radio waves. The operation of the set itself is dis ed in six chapters, commencing with discussion on aerials and proceding ough valves, detection, amplification, akers and headphones, to mains ver supplies.

A chapter is devoted to types of re ers and discussion of typical receiver ts, followed by one on television, ther on the cathode ray oscilloscope, a brief discussion on radar. The k concludes with a useful glossary erms and commonly used tables.

Altogether, a useful addition to any nner's library.

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Let's Buy An Argument

On two or three different occasions over the years, I have received letters along the lines of the one opposite, suggesting a possible "cure" for atmospheric static. I wonder whether any readers have acually tried this particular scheme, or known anybody who has done so.

by Neville Williams

OF course, there might easily be peals of laughter at my expense, instead of our correspondent's, and sheafs of letters quoting all kinds of references which I should have seen in the normal course of technical reading.

But I haven't. Have you?

In any case, I can assure D.T. that, even though his idea is original as far as he is concerned, it is certainly not the first time that I have heard of it and there lurks at the back of my mind an idea that it has been raised once before in these columns.

BASIC IDEA

The idea is simple enough. You take two receivers, tune one so that it receives a desired station plus static and the other so that it receives static only from an adjacent frequency channel. You then combine the outputs in opposite phase in the hope that the static components will cancel and leave only the signal.

As our correspondent remarks, the idea is so simple and obvious that it is a wonder that it hasn't been tried before. Well, it has certainly been suggested but tried or exploited . . .? That's what I'm asking right now!

Actually, there would be a good deal more to the whole scheme than D.T.—or previous correspondents—have possibly imagined. I can think of quite a few complicating factors.

Actually, D.T. does mention the first one himself, namely, the difficulty of picking a pure static signal. It would presumably have to come from an adjacent frequency channel, for it to be a near replica of that superimposed on the desired signal.

But would it be possible to find, on today's crowded frequency bands, a suitable clear channel from which "pure static" could be received. The practical answer to this may easily be a flat "No," rendering further discussion pointless.

In case anyone has a further inspiration, it would not be an answer to use an inordinately selective receiver to pick up the static. The audio frequency content of an amplitude modulation type receiver is highly dependent on the shape of its selectivity curve and one might expect that the two receivers in question would need to be exact duplicates in their selectivity and audio passband for cancellation to take place.

They would need to be matched in gain also and controlled by a common AVC system.

INTERMODULATION?

Another problem might easily arise from the tendency for loud static crashes to intermodulate with the incoming signal in the number 1 receiver, to produce noise components additional to what could be attributed to static alone. Such additional components would not be cancelled by the out-of-phase connection since they would not be present in receiver number 2.

A still further point is that the system (if it worked at all) would be most valuable on weak signals, prone to static interference. On such signals, inherent receiver noise might well be apparent.

The noise in the two receivers would have no basic phase relationship, so that it would not cancel but rather add to deteriorate the overall signal-to-noise ratio. Add the possibility of stray sid

band chatter on the number two receiver and the end result may not be a very attractive one.

And even at best, what order of cancellation would be realised? Would the static components from one channel remain faithfully out of phase at all audio frequencies with components from the adjacent channel?

I have my doubts.

NOT SO EASY

In other words, the scheme would at very least involve the use of two receivers balanced to give partial but probably incomplete cancellation of the basic static signal. In practice, the number two receiver would most likely pick up stray broadcast signal as well as pure static, would introduce additional incoherent receiver noise and fail to cancel intermodulation products.

As I said earlier, I have never heard of anyone ever having exploited the idea successfully, though that doesn't prove that it hasn't happened.

To the best of my knowledge, the closest approach is found in so-called "diversity reception," where two or more receivers are used, but tuned to the

sired station. They are fed from different aerials, possibly in widely separate locations but their functions and circuits are interlocked so that, at all times, the system is dominated by the unit which happens to be receiving the strongest signal.

What with this and manual control, the worst effects of fading and local noise can be minimised. And, after all, these might be a worse problem than mere static.

A further point is that communication receivers are normally fitted with noise limiter circuits, which clip off modulation peaks above a predetermined level. This operates without in any way increasing the noise level in the receiver itself.

THE BETTER WAY?

All this adds up to the thought that, if you must use two receivers to obtain adequate resolution of the signal, they are best used with noise limiting and to the "diversity" principle, rather than in the fashion suggested by D.T.

The second letter on this page, from H.C., is one which I do not propose to answer in detail, for the simple reason that an answer is implicit in a rather lengthy article by the editor in this very issue.

The broad summary of the matter is simply this: Considering cost, complication and performance, the accepted "best" method of building a basic amplifier at the moment is to use output valves to produce a low natural output impedance—as triodes, as ultra-linear or cathode loaded—then apply overall negative feedback between the transformer secondary winding and some point much earlier in the circuit.

Practically all amplifiers, these days, are designed along these lines.

While good speaker damping and very low distortion can be secured by such means, the basic frequency response of the amplifier cannot be left to chance. In the regions where the response begins to droop, as droop it must, the influence of reactive components begins to rotate the phase of the feedback from purely negative toward a positive relationship.

MAY OSCILLATE

Unless this change in phase can be controlled by deliberate initial design or "doctored" after it has been observed, there is a strong chance that it will create a regenerative condition sufficient to make the amplifier oscillate at some supersonic frequency and under certain conditions of output load.

As the editor points out, the most important single component in determining what happens to responses and feedback phase is the output transformer.

It would be just fine and dandy if a transformer could be dreamed up which maintained full response and zero phase shift up to some specified frequency, and thereafter passed into some nebulous, passive, inactive state. But transformers aren't like that.

They can certainly be designed for near-perfect characteristics over the entire audio spectrum, but, in so doing, it is impossible to avoid a very substantial response in the immediate supersonic region, with gradually deteriorating characteristics stretching right up into the RF part of the spectrum.

This is where the phase rotation occurs, and, with it, the chance of regeneration and oscillation.

Nor is it always possible blithely to "roll off" the response of other sections of the circuit to solve this problem, because the very components, which are used to secure the roll-off, do it by introducing reactive effects, and, therefore, phase rotation of their own.

The cure strongly resembles the complaint.

Hence the manipulation of transformer characteristics, step circuits and phasing capacitors as described elsewhere by the Editor in his article.

In the process, the response of the amplifier may end up as flat to 20, 50, 100 or even 200 Kc. But the response isn't an end in itself and is not quoted as such.

It is basically and essentially a by-product of the designer's efforts to secure near to perfect characteristics over the audible spectrum with stability under the widest possible and even the most unlikely conditions of output load.

It is therefore in no sense deception or "rubbish." In most cases it is a simple statement of the inevitable.

INPUT CIRCUITRY

In practice, nearly all such basic amplifiers are intended to be used with auxiliary input and control stages or networks and these invariably have a much more restricted pass band. The overall response of the equipment is therefore likely to be much nearer the accepted range of hearing and as much is usually evident from the specifications.

A final point is that information is woefully lacking regarding the fastest transient effects present in modern reproducing systems and whether such effects find any significant reaction in ears which seemingly have too low a cut-off to hear them.

The chances are that the "perfect" audio system need be no wider in response than the best ear available to listen but this concept could be wrong.

If it is wrong, H.C.'s reference to deceit and rubbish could be doubly misplaced.

Two or three other letters on different subjects may well be discussed in the space which is left.

One of them, from a reader in Killara, N.S.W., refers back to the discussion on valve plate resistance, in the September issue. You may remember that I queried the use of the terms "plate impedance" and "plate resistance" when the quantity in question was more correctly designated as the "dynamic plate resistance."

Our correspondent writes:

Dear Sir,

Do you really think the word "dynamic" in "dynamic plate resistance" is redundant?

Surely the "dynamic" is necessary to distinguish it from the static plate resistance (dE/dI or dea/dia), obtained from the slope of the anode voltage/current curves.

I have measured the plate resistances (dynamic and static) of the 6J7 by means of an impedance bridge and the slope of the curves respectively and obtained differences of about 20 pc. if my memory is accurate.

Yours sincerely, A.M.

I must confess that this letter puzzles me, because, on the surface, it is self-contradictory.

CURE FOR ATMOSPHERIC STATIC?

Whilst glancing through a copy of "Radio and Hobbies" several years old, I came across a reply to a correspondent who wanted some magic formula for eliminating static. He was informed that a fortune awaited the inventor.

From this point on, roars of laughter will probably be heard for several blocks away but I am enclosing an idea for which I claim full originality, regardless.

Why such a simple principle hasn't been tried before, if it works, would be incredible.

The general principle of operation is as follows:

(1) A signal is picked up by a receiver in the usual way.

(2) Another receiver is tuned to a nearby frequency but where no station is operating (wishful thinking). The first receiver is picking up both station and static, the second receiver, static only.

(3) The two receivers are fed to a suitable mixing stage, 180 degrees out of phase. The two static components should cancel if adjusted to equal and opposite amplitudes.

If not workable, you may comment if you care to in the "Argument" page, signing me as:

Yours Faithfully, D.T.

Deceit, rubbish

Dear Sir,

I would like to buy an argument about HI-FI equipments.

From the "Radio Physics Course" by Ghirardi, I read as follows:

"By impressing sounds of various measured frequencies on human ears it has been found experimentally that the normal ear is able to detect sounds of frequency about as low as 16 cycles per second and as high as 20,000 cycles per second, but not with the same degree of sensitivity.

"Vibrations slower than 16 per second do not sound as a tone; they separate into 16 or less separate noises. Above 20,000 vibrations per second, the vibrations are so rapid that the ear drum membrane and associate parts cannot follow them."

Here is my argument: If a normal ear cannot follow vibrations superior to 20 Kc. what is the purpose of boosting the response to 50-30,000 or even (see R. TV and H) response 50-100,000 cycles? What is the use of the 80 Kc. more than we can hear? Why deceive people with such rubbish?

Yours sincerely,

H. C. (Melb.)

HI-FI

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By definition, the dynamic plate resistance is the Ohmmic relationship between a small change in plate voltage and the resulting small change in plate current, all other voltages remaining constant.

Yet A.M. expresses the same relationship in mathematical terms and tries to call it something else. Where's he getting tangled up, or is it me?

Is he trying to differentiate between a "small change" effected in a cyclic manner and a small DC shift over the same range?

Or is he trying to make a point of difference between the valve alone and the valve in some kind of associated circuit?

Either way, I fear that he's on the wrong track.

The dynamic plate resistance is a property of the valve alone and is always defined and quoted as such. I don't see that it makes the slightest difference whether you describe it in so many words, as we did originally, or by the mathematical terms used by A.M.

FROM CURVES

The dynamic plate resistance of a valve can be estimated from the plate family of curves by drawing a straight line on the graph having a slope similar to the slope of the relevant characteristic curve and at the point on the curve in which one happens to be interested.

By selecting any convenient section of the new line and relating it to the voltage and current co-ordinates on the graph, the equivalent resistance it represents can be worked out by Ohm's Law.

However, it takes only half an eye to see that the slope of the curves and therefore the dynamic plate resistance of a valve varies considerably with the particular operating point. In fact, while the plate resistance of a triode is fairly low over the greater portion of the graph area, and while that of a pentode is fairly high, there are extreme regions in both cases where the reverse is true.

For any given valve type, the dynamic plate resistance quoted by the manufacturer is therefore either related to a definite working point or is a purely typical value for conditions under which the valve is most likely to be used.

It must also be realised that there is a limit to the accuracy with which one can judge the slope of curves on a small and often not-very-well printed graph. A fair amount of the discrepancy found by A.M. could originate right here.

HOW DRAWN

Then there is another point, on which I can speak with authority, having at former times had to originate such curves for publication.

The curves published are the result of tests taken with one or possibly more valves, carefully selected on the basis that it (or they) exhibit characteristics as near as possible to the target average for the particular type. If not done by oscillographic means the tests have to be carried out in careful sequence to minimise ageing effects while they are in progress.

But here's the point: Though other valves may exhibit figures and curves very like the specimen, and with tolerances either way, none will duplicate it exactly. Whole batches may even wander one way or the other in various respects by reason of production and quality changes.

One must therefore expect results, at

easured on any given specimen valve, vary from the published figures by ite a few per cent—and this takes no ccount of the accuracy of the several eters required to monitor and measure ll the electrode voltages.

I do not know how A.M. did his npedance measurements, but it would e vital to have no external resistance r impedance in the plate circuit under easurement because, by IR drop, this ould involve a slightly different voltage hange at the plate pin to what was ffected at the circuit supply point.

By the same token any resistance uncounted for in the screen supply circuit f the cathode circuit would prejudice ie final readings.

In other words, far from believing iat the 20 per cent discrepancy menoned by A.M. proves anything I should e surprised that he obtained such an rder of agreement.

But it does lead to a thought which ur correspondent could possibly have in iind. If "dynamic plate resistance" is property of the valve alone, what name o you give to the apparent impedance f the valve when it is wired in a typical rcuit and operating into some kind of oad impedance?

TAGE AS A WHOLE

Frankly, I don't know and it's possibly ot necessary to invent a name. Once ie valve is considered as part of a cirit we're more likely to start talking bout the output impedance or source npedance of the stage as a whole.

From K. M. in Toorak Gardens, S.A., omes the letter on this page asking bout the polarity of diode symbols in rcuits and their markings as sold over ie counter.

I fully agree that this has been the ource of much confusion and, as a magzine, we must accept our share of the ame.

However, the explanation is simple ough. For many long years, the only ne the arrowhead symbol appeared for detector, at least in the popular techcal field, was when it was used to deote the crystal in a crystal set. Since olarity is unimportant in this applicaon, nobody bothered very much which ay it was shown or which way it was onnected into circuit.

When applications came along demandg attention to polarity, it was very difcult to establish what was the correct ethod of representation. At least we ound it so. Some showed one method, me another. Without checking back n past circuits it's quite likely that we ere inconsistent ourselves, as a result of is early confusion.

With the wide use of diodes in telesion and transistor circuits, we clearly id to adopt some definite standard and ne of our staff members, who is parcularly interested in such matters, was conded to look into it.

His verdict was that the arrowhead ould always point in the direction of onventional current flow. This happens be in line with paragraph (a) in our orrespondent's letter and with what has pparently been traditional practice with ctifiers generally.

I haven't checked the point personally. Thus if the rectifier were to be reaced by a thermionic diode, the arrow ould point from plate towards cathde.

As far as we can determine, manuacturer's practice is to mark the "cathde" end of the diode, so that this is furer shown as positive in the circuit diagram. It is justified by the fact that, in use, the cathode of a valve rectifier or the equivalent marked end of a metallic diode is at the positive end of the DC output load circuit.

I guess that this will remain our standard procedure from now on, unless someone manages to kick our proverbial legs from under us.

The second letter on this page, from a reader in Singapore, is likely to make one blink a little. I must hasten to assure H. T. that, whatever the attributes of this so-called "Contra-Polar" energy, it could not bring about the effects he mentions.

But where would he get such an idea. Has some reporter in a daily newspaper let his imagination run riot? It sounds rather like it and it wouldn't be the first time.

POLARITY OF DIODE RECTIFIERS

Dear Sir,

For many years now I have doubted the authenticity of the germanium diode polarity in certain radio circuits. Many arguments have arisen between my colleagues and I concerning this debatable point. Would you please observe these factors:—

(a) I know for a fact that the arrowhead indicates the direction of conventional positive electricity, the rectificational properties being discovered before the discovery of the fact that electricity consists of a flow of electrons.

(b) In your article "A New Full Range F.M. Tuner" written by Mr J. Moyle, the arrowhead was indicated as being positive. This would indicate the forward condition.

(c) In a well-known technical data booklet, "Transistor germanium and silicon diodes," published by a very well-known and reliable firm, they described a transistor signal tracer. The diode polarity here was indicated to be "Cath" at the arrowhead, this also being the case in all other well-known books. In this case the inverse condition is shown and, if tested with a V.T. Volt Meter, the voltage would be as per marking, the other cycle being conducted through the diode.

If polarity in the thermionic valve were marked, the forward or current carrying condition would be indicated.

I wonder if you would like to buy this argument and perhaps clear up the discrepancy in your popular pages.

Yours faithfully,
K.E.M.

NEGATIVE ENERGY

Dear Sir,

As referred to the Radio Television and Hobbies of August, 1958, issue, I am very interested to read the article about "More to Boiling Than Meets the Eye" by Calvin Watkins.

I understand that this is a "Positive" Energy. I have heard that some scientists in America have experimented with the other way "Negative" energy known as "Contra Polar" Energy. This power will turn an electric lamp into black light and also freeze up the water in an electric kettle.

Can you find out what generator or power to produce "Negative" energy.

Thank you.

Yours faithfully,
H. T. (Singapore).

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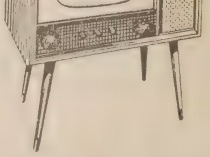

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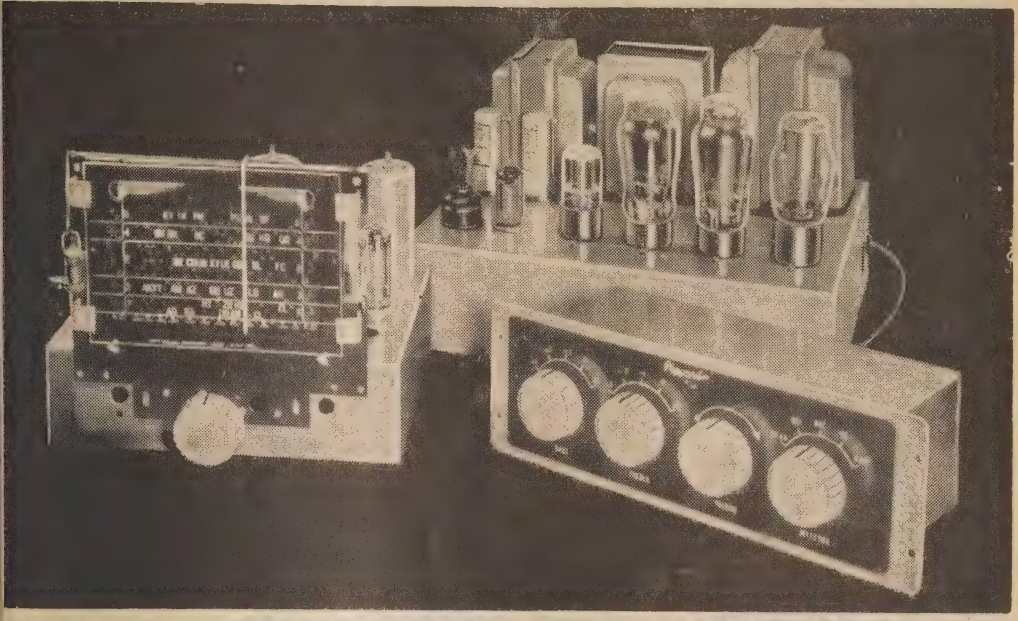

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Featured in "R. TV & H." August, 1958.

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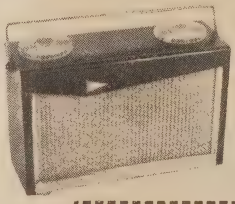

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OFF THE RECORD — NEWS & REVIEWS

The problem of providing reproducing heads which will play all types of gramophone records has been one of the big difficulties facing commercial users of stereo. Even now it is hard to see what the solution may be, and it is probable that several will be tried before the situation clears.

by John Moyle

THE point at issue is whether the stereo cartridge and stylus will play single channel records successfully.

If they will, there would be no great problem in producing a multi-use cartridge, but it's becoming clearer that the answer is likely to be a qualified one.

Ideally a pick-up should have a choice of three points—one for 78s, one for single channel, and one for stereo.

There is no hope at all of combining the 78 stylus with either of the others, so we must count it as a must unless we are prepared to abandon it altogether. Most people wish we could!

But the manufacturer of radiograms is very reluctant to do this, because, no matter how few are the 78s his customers will play, he is likely to be passed over if a competitor can offer all this and 78s as well.

Being left with the remaining two styli, the temptation to select a diameter which can be used in place of both types is very great.

The best diameter for stereo, and the recommended value internationally, is the .5 mill stylus. The best diameter for single channel records is a 1 mill point.

The 1 mill stylus is not good for stereo. Not only is the point too large for the highest quality, but it rides too far up the finer groove and will ruin its shape in practical cases.

CAN BE USED

The .5 mill stylus will sit too far down the single channel grooves in the case of many discs made some years ago, but is a reasonable fit on recent releases.

But because the grooves were not intended to be played with such a fine point, manufacturers did not control disc contours in all cases to such standards as would make the .5 mill point completely safe.

Thus we find in the U.S.A. particularly, a stylus point of .7 mill being used as a compromise. But in England, at least one of the biggest pick-up manufacturers is decidedly against this practice, and most English pick-ups seem to be using .5 mill.

To further confuse matters, I recently tested quite a good player unit which confessed to a .6 mill stylus.

It seems pretty clear, however, that it's not very practical to make cartridges with more than two permanently fitted styli, and even these pose problems when applied to the double-section stereo cartridge.

Because it is difficult to arrange for stylus coupling into the sections from more than one point, manufacturers are arranging to turn the stylus arm rather than the cartridge. The arm carries two stylus points to allow for this.

Others tip the cartridge with a rocking motion to allow one or two stylus points to rest on the disc.

Another method is to use separate clip-in cartridges, so that no dual-purpose units are involved. This is more awkward from the average user's point of view, but a good idea from the viewpoint of efficiency.

At the moment it looks as though a turnover stylus arm with a compromise point for stereo will be the most popular answer for average radiograms.

The first shipment of stereo discs was about to arrive as we went to press, but the demand here has been beyond expectations, and the shipment will go only part of the way towards meeting it.

The huge consumption of discs in England, and particularly in America, has placed a big strain on manufacturing resources, and this may be reflected in short supplies here for some months.

Most record companies are still not anxious to talk about release dates, and understandably so, as they have their stock positions to consider, with the Christmas trade coming up.

They know, too, that once stereo gets under way, there will be no turning back.

An interesting point during the month was the release, on Durium label, of the first 16 r.p.m. records in Australia.

This is an Italian firm, and the discs give about one hour per side of popular music.

Quality, although not equal to standard speeds, is surprisingly good, and quite adequate for the purpose.

These records will give many radiogram owners a chance to use their fourth speed for the first time.

They play with the ordinary 1 mil stylus as used for normal L.P.s

THIS MONTH'S RELEASES ON RECORDS

SCHUMANN—Frauenliebe und Leben; MOZART—Nine Lieder. Sung by Irmgard Seefried, Soprano. DGG LPEM 19112.

Your reaction to the Schumann will depend a good deal on whether you like the recorded version of the singer or not.

In this cycle she frequently uses a small, controlled and almost sexless voice which is pure but expressionless.

It is, in fact, the first sound that you will hear, and I for one found it rather unpleasant.

Later on she improves, and most of the cycle she sings well.

This is the cycle which Lehmann made particularly her own. One of the few times I have been reconciled to a soprano concert was in Sydney before the last war when she sang it.

Most people will agree with me that no other singer has done it so movingly. Seefried cannot command the same range of emotion.

I liked the Mozart songs much better. They suit the singer's pure tone more happily—they do not call for the same flexibility and extremes of poignancy and rapture which Schumann demands.

The recording as such is very clear and quiet, making the most of the singer's fine diction. The accompanist supports her firmly and with imagination. Neither voice nor piano is particularly forward.

CHRISTMAS IN ENGLAND.—Carol Service in a Country Church. Fifteen well-known carols. R.C.A., L10496.

INTERNATIONAL CAROL CONCERT.—The Obernkirchen Children's Choir, 13 Carols of All Nations. Parlophone. PMDO7510.

The first is an attractive collection, sung by a typical church choir and congregation, with support from the organ. The church atmosphere is preserved even to the sound of the people rising to sing, and the rustling of papers as they turn the sheets.

The second is a much more sophisticated presentation of young voices, carefully trained and arranged by a competent hand.

This arrangement has perhaps prejudiced some of the freshness we associate with young voices, but it is quite effective in its own way.

Both recordings are excellent.

BEETHOVEN—Symphony No. 6 in F, Opus 68 (Pastoral); Consecration of the House Overture. Played by the Pro Musica Orchestra, Vienna, conducted by Jascha Horenstein. Vox APL 10410.

First impression is of the fast, almost headlong pace of the first movement as compared with that of standard versions. Clearly Horenstein isn't going to produce it phrase by phrase, but to shape it broadly and steadily. This seems to be his standard form.

And he is very steady indeed. Only the smallest variations in pace are allowed from start to finish.

By strange contrast, he plays the third movement very much more slowly than most, and about half the pace of Toscanini.

Second impression is that the orchestra is light in weight, probably because the bass instruments are placed well back from the microphone.

This has given a particularly good ear to ful of the other instruments, especially

woodwind, which have many individual contributions to make.

But it also gives the impression that there is often a good deal going out in the echo that we don't properly hear.

It has reduced the sudden blast of storm to an undramatic happening, and even the storm itself mutters pretty much in the distance with little of either bark or bite.

For all these characteristics it isn't a dull performance, and the playing is mostly very good.

It just hasn't the full colour and drama we generally receive, and without some of which the last movement particularly can easily drag.

The fill-up item is not one of Beethoven's best-known overtures but is played vigorously and with rather more hall echo than in the symphony. This clouds the sound although it adds to its size.

The surface is good and there are no obvious cutting faults.

★ ★ ★

THE WORLD'S BEST LOVED WALTZES—played by Morton Gould and his Orchestra (Sleeping Beauty, Roses of the South, Valse Triste, Vienna Beauties, Invitation to the Dance, Gold and Silver, Village Swallows, Fledermaus). RCA L16121.

My remarks about these waltzes may not be as enthusiastic as those on the cover note, but I found them pleasant enough.

Whether Morton Gould penetrates their lyric souls and set them free to soar as they were meant to do, or whether he does not, I will leave you to decide.

★ ★ ★

PERGOLESI. — Salve Regina; Stabat Mater, by Bruna Rizzoli, soprano, Claudia Carbi, contralto, Chamber Orchestra and Women's Choir of the Teatro Comunale di Firenze conducted by Francesco Molinari-Pradelli. Philips A 00446L.

Pergolesi, one of the early figures in Italian music, is best known by his opera La Serva Padrona recently released for Columbia, and this Stabat Mater, generally agreed to be his last composition. Although only 26 when he died, Pergolesi produced a large amount of music, mostly unsuccessful in his lifetime and virtually forgotten after his death.

One exception was the Salve Regina which is also included on this disc.

These three works represent probably the best of Pergolesi and certainly illustrate the range of his style and expression.

There is a tremendous leap from the pages of La Serva Padrona to the moving dignity and pathos of Quando Corpus of the Stabat Mater.

This record is issued under the auspices of Monumenta Italicae Musicae, the aim of which is to present authentic versions of historical Italian music. Apart from its authenticity, it is most beautifully performed and recorded.

Of the soloists, the contralto is particularly good. The choir is the least impressive, but it has not a major part to play.

The surface is one of the best I have heard, or not heard, for a long time. Good though many of our local pressings are, they are rarely equal to this standard of smoothness and silence.

MONTH'S BEST DISC IS "PICTURES" FOR PIANO

Brilliant, imaginative playing and technical quality are features in this unusual record of music more generally heard in orchestral versions.

MOUSSORGSKY.—Pictures At An Exhibition; STRAVINSKY.—Petrouchka Suite; BALAKIREV.—Islamey (Oriental Fantasy). Played by Alfred Brendel, Piano. Vox LPL 9140.

Very good indeed—a bright spot of the month. The Pictures is the star piece. Nearly every record now issued of this famous composition is the orchestral arrangement—so effective that the original piano version will sound strange to many ears.

But this is a most brilliant piece of work—enormously vital and imaginative.

The pianist is so completely in command of the great technical difficulties that he is able to extract effects and build a series of vivid pictures unhampered by any need to modify his performance to make sure of the notes.

How firmly he handles the Promenades—each one different and yet so right as the joining flux which brings the whole work together.

He does equally well in the beautifully sustained Troubadour's Song as in the Polish Jews, for instance, and the Hut on Fowl's Legs, where atmosphere and brilliance join each other.

His handling of dynamics is often electrical, his power tremendous, and his full tone foreshadows the orchestral treatment which was to come later on.

I thought this magnificent work.

Some may not like the speed at which he thinks and plays, but I found each section a bright, strongly coloured scene, all the more effective for the direct methods used.

Petrouchka is little if any inferior in its masterly portrayal of the orchestral colour and Brendel's complete understanding of it.

Here as elsewhere the piano recording with its deep bass and clearly marked treble is an essential part of the definition and clarity.

The Balakirev suffers in stature as compared with the others but is a brilliant and tuneful display.

Technically, and musically this is a first-class disc. The surface noise is virtually inaudible.

★ ★ ★

BRAHMS.—Symphony No. 2 in D Major Opus 73. Played by the Los Angeles Symphony Orchestra conducted by Alfred Wallenstein. World Record Club TT8.

A performance which hasn't the subtlety of colour exhibited by some others among the nine versions I now have. This large number explains why I do not attempt very much in the way of comparison.

The Los Angeles orchestra emerges over-all with great credit, although its style is more direct and less relaxed than many European orchestras with

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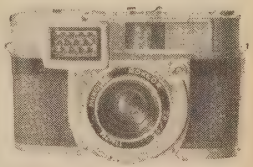

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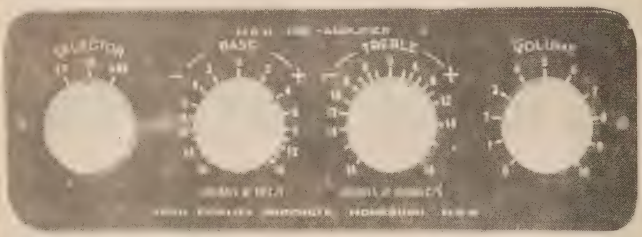

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whom, alter all. Brahms is a tradition.

And as this symphony is played by practically every group of world standing, the competition is hot indeed.

This orchestra is musical, more so than several much more brilliant compatriot orchestras. If at all times, its work hasn't high polish, it always comes off. Wallenstein is not a showman and his reading is just about as straight as it could be. This is refreshing when compared with the variable effects some conductors inject into it.

The surface was a bit noisy at the commencement of each side, but this may be simply a characteristic of my pressing.

★ ★ ★

TCHAIKOWSKY. — Excerpts from Swan Lake Ballet. Played by the Royal Covent Garden Opera House Orchestra conducted by Jean Morel. R.C.A. L16143.

Apparently this is R.C.A.'s answer to the several Swan Lakes which have been released in the past few months.

The Covent Garden Orchestra should know by now how to play Swan Lake; at any rate they do it very well here.

The issue which impressed me greatly in recent months was by the Philadelphia Orchestra. Covent Garden doesn't produce the same impression of faultless and glamorous playing.

But its quality is quite good enough to put it in the preferred class, at least among the three or four versions I was able to compare.

Technically, the recording is sharply outlined, clean, and rather hard-pitched. At its best it's high class, and at its worst it lacks somewhat in bloom, if I can use so nebulous a phrase.

My only serious quarrel is with the solo violinist whose performance is not certain and whose tone not as good as I'd like.

But all in all it is a good issue—it left me with a feeling of time well spent.

And that's not a bad test.

★ ★ ★

BRUCKNER—Symphony No. 9 in D Minor. Played by the Concertgebouw Orchestra of Amsterdam, conducted by Eduard van Beinum. Philips A00390.

The immediate comparison is with the Vox recording reviewed elsewhere.

The Vox is by far the most rugged version. Its climaxes are more pronounced and a good deal more impressive.

As a result, the work sounds bigger than with van Beinum, who has, nevertheless, taken care to make every bar count.

He examines many passages almost with gentleness—passages through which Horenstein marches through to the heights which to him are much more magnificent and overwhelming than they are to van Beinum.

Horenstein's pace, too, is much faster, notably in the last movement, in which van Beinum's preoccupations tend to make the music drag.

The Philips recording is very good. It has plenty of body, the all-important bars come through cleanly and with a smooth tone, the innumerable quiet passages for wind and woodwind are clear and well balanced. Dynamic range is high and surface good

It adds well to previous good Concertgebouw recordings of Bruckner.

BACH'S ROYAL INSTRUMENT—Toccata and Fugue in D minor, Concerto in D minor after Vivaldi, Fugue in C major, Fugue in G minor, Passacaglia and Fugue in C minor. Played by E. Power Biggs on the Organ of Symphony Hall, Boston. Coronet KLC 644.

Not often do we have the opportunity to collect so much fine organ music so well played on a single disc.

I don't know why so many should shy away from the notion of listening to a Bach fugue. Not all of them are immediately appealing and some are extended and involved.

But many are quite easily and instantly appreciated by any musical person who cares to take the trouble.

Both the Fugues in C major and G minor are in this class. Particularly in the latter, the registration is remarkably clear and attractive.

This is probably the best feature of the record, and applies throughout. It's mostly to do with the recording and partly with the hall.

The one has used microphone placement close enough to avoid loss of clarity due to excess reverberation, although the hall doesn't appear to have a great deal.

The result is not completely baroque but certainly not cathedral. When the big notes are used, they have a good deal of power and weight, but no confusion. They are always well separated, as should be if your equipment is good.

The organist is well known for his work, and is one of the most experienced in the world today. He plays without the patriarchal style of Schweitzer, but with more youthfulness and enterprise. He is a most attractive organist, sure in outlook, a fine tone builder, and with a masterful judgment of shape and dynamic values.

The recording is particularly good, among the best I have, and includes some sections of truly magnificent sound. Only on one or two occasions did I detect a slight rattle—mostly it plays faultlessly.

Heartily approved for music, performance and recording. Even the D minor sounds fresh.

★ ★ ★

BRUCKNER—Symphony No. 9 in D Minor. Played by the Pro Musica Symphony Orchestra of Vienna conducted by Jascha Horenstein. Vox APL-8040.

Just to remind you that their fine single-disc Beethoven Ninth wasn't a fluke, Vox now offer you a magnificent performance of the Bruckner Ninth which is noble, majestic, and often thrilling in its stature and size.

And without these things, it might just as well not be at all, for this was the composer's last big work and probably his greatest.

It needs spacious sounds into which it can expand, and the extra reverberation which has been given to it I thought just right. No one in his right mind would sit too close to a giant such as this.

There are a few rugged moments, such as occur in the first few minutes of the Scherzo, where the sound seems blurred under heavy weight.

On the other hand, this is just the effect the music should have, and it gets lost in listening to the great force and drive of this remarkable movement and the quality of the playing in the centre section.

It's a great pity the movement had to be cut in half.

I have never worked out which orchestra the Pro Musica really is, but it shares the Viennese ownership of a fine brass section.

It's just as well for it gets a real workout here.

And yet the things I liked best about this record weren't directly matters of tone quality, polish and the like.

They were sincerity, vitality, musicianship and a feeling that the players were dealing with ground they knew. You'll buy it for these things first of all; it may be quite a while before you get around to looking for the rest.

Despite a wide dynamic range the surface at its worst is barely audible.

★ ★ ★

GRIEG—Music from Peer Gynt played by the Royal Philharmonic Orchestra conducted by Sir Thomas Beecham with the Beecham Choral Society and Ilse Hollweg (soprano). H.M.V. OALP 1530.

Most impressive, right from the first note.

First of all, Beecham underlines the fact that the Peer Gynt music includes some of the best Grieg ever wrote.

Grieg cannot aspire to greatness in the grand manner, but in common with several other composers he was able to build an individual kind of music and orchestration, beautifully effective despite its generally obvious methods, devices, progressions and the like.

It needs a certain touch to do it justice. Its quality must be coaxed from the score. There is air-beating and even vulgarity lying as a trap in excerpts, such as the Hall of the Mountain King, and there is poignancy elsewhere which can easily be missed.

Beecham's hand and touch are very sure—alone they would be sufficient to guarantee something better than just another play-through.

In addition, we have a particularly fine and well-balanced recording.

It sounds rich and round and clear, giving full definition to the many significantly turned phrases and subtle effects over which Beecham has taken much care.

The music of both Suites is here, together with two more excerpts not generally included.

Solveig's song is a highlight.

I can't see you passing this by when looking for Peer Gynt

★ ★ ★

CHRISTMAS HYMNS AND CAROLS, VOLUME II—Sung by the Robert Shaw Carols. R.C.A. L16141.

Here are 25 of the best-known Christmas favourites sung in just the way I feel they should be.

I have been so often disappointed with Christmas records. Sometimes it is the recording, at other times the intrusion of too many bells and gongs and effects. Often the arrangements have been modernised or otherwise dealt with until much of their simple, and even old-fashioned, character has been lost.

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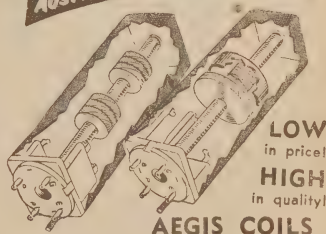

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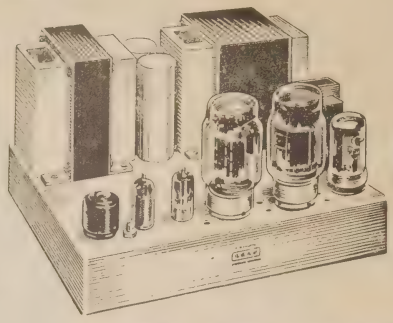

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But these are just right. What is more hey are unaccompanied, so that not even n inadequate or too powerful organ etracts from the fact that the singers an keep in tune and blend extremely ell.

The recording is equally good.

I can't remember when I have been ble to praise a Christmas record so reely.

★ ★ ★

RIMSKY-KORSAKOV — Cappriccio Espagnole, Flight of the Bumble Bee, Dance of the Tumblers. TCHAIKOWSKY — Cappriccio Italien, Andante Cantabile. Played by the Philadelphia Symphony Orchestra conducted by Eugene Ormandy. Coronet KLL580.

The best item could well be the one hich isn't Cappriccio — the Andante antabile.

The string playing and tone and nsemble here are lovely indeed, even the pace is rather brisk.

But the surface of my disc was rackly, and that didn't help the orches- a one bit.

Frankly I like the music arranged for rchestra as well as in its original form You won't hear it more beautifully layed.

The rest are presented as the Philaelpia orchestra loves to be heard — a igh-powered machine smashing every ymbal and flashing every bow.

I made a mental query on the cymals—if you are hi-fi they might sound bit fluffy in the Cappriccio Italien.

The Rimsky-Korsakov side had a very uch better surface and rather more pulent sound with some lovely wood ind — notably the cor anglais in its amous solo against a background of chly sounding strings.

Incidentally, a cautious hand might ave reduced the impact of one or two idden entries. I had some difficulty in econciling levels from time to time but erhaps I am fussy

For sheer virtuosity, the Bumble Bee is nique. I have never before realised ow like a bee it really does sound.

Altogether I don't see how you can be isappointed in this disc.

★ ★ ★

ENESCO — Roumanian Rhapsodies Nos. 1 and 2. TCHAIKOWSKY — Francesca da Rimini Overture. DVORAK—Carnival Overture. Played by the Philadelphia Orchestra conducted by Eugene Ormandy. Coronet KLC 674.

For an orchestra which has never been ackward in coming forward with the ass, Carnival struck me as being unsually light in this respect.

Several notches of boost did not improve matters so I concluded it was neant to be that way.

Francesca da Rimini reinforced this lea, and it also increased my admiraon for the almost unrivalled ability f the orchestra to put on a dazzling echnical show.

It is saturated with an atmosphere of ortured brilliance and despair

No other orchestra on record can roduce music so potently charged and certainly have never heard such an inredible clarity and precision as in the rst part—"Gateway to the Inferno."

This is filled with the most complex attern of wails and entreaties which rmandy has developed in vivid proramme, and which the players have ractised to perfection.

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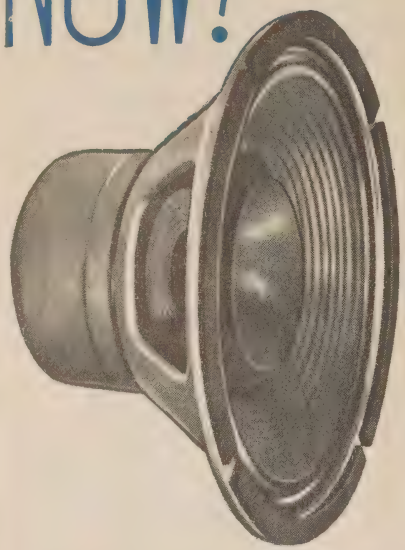

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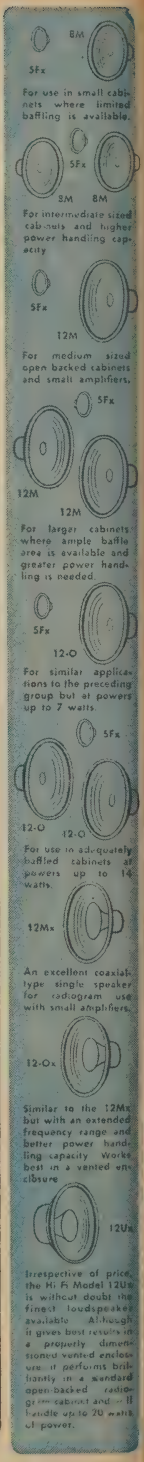
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It may sometimes sound anti-climac-al and overpowering, but it is a mag-ficent piece of orchestral work.

Apart from the rather light bass end, e recording is taut, laced with concert ll atmosphere, and potent in the ex-eme.

Carnival is treated in the same general percharged vein, in which the pressure matched only by the ease with which is applied.

The Enesco Rhapsodies are fine. They e favourites of mine, and of most eople. Occasional subtlety—not to be nfused with flexibility—might have im-roved things, but I thought they were eat.

I'm too shattered with Francesca to rite any more!

★ ★ ★

SOUTH PACIFIC — Selections played by Percy Faith and Orchestra. Coronet KLL579.

No matter how often you have heard uth Pacific music, you will want to ar it again as Percy Faith presents it.

All 12 numbers are arranged for chestra and played with the full amour and glory for which Faith is mous.

It is not only the music and the play-g of it which is so good. The record g as an example of its kind is in top ass.

It has an enormous dynamic range hich not only allows full value from e freely used effects but holds up each imax into rich and sweeping sound.

Its frequency range and general bal-ce give it a rating very little short of monstration standard.

It is splendidly cut — I could not find fault with it. Surface noise is so low u can forget it.

In brief — a disc and a half.

But for that matter I haven't heard a rcy Faith make a bad one.

★ ★ ★

BACH — Brandenburg Concerto No. 1 in F major played by the Little Orchestra Society of New York conducted by Thomas Scherman.

Brandenburg Concertos No. 2 in F major and 3 in G major played by the Los Angeles Symphony Orchestra conducted by Alfred Wallenstein. World Record Society TT7.

The two sides present a contrast in yles, the first being played by a small chestra in a small, intimate recording amber, and the second a symphony chestra with much more weight and verberation.

On the whole the latter has the greater ccess — its efforts are more cohesive d sophisticated, and indeed they come it very well.

The smaller combination in many ways s the harder task. It is quite difficult strike and preserve a recording balance ith such a combination of instruments.

Most of its work is deft and sincere. t there are a few spots where co-rdination appears to falter, and the ality of recording seems to vary from e section to another. Frequently the ality of tone is thin, but if it comes that the original instruments were not markable for their body.

The larger orchestra makes the most its wider scope and plays with plenty vitality.

Recording quality is good average nd e surface better than most.

ROSSINI-RESPIGHI—La Boutique Fantasque; SCHUMANN-GLAZOUNOV—Carnaval. Played by the Royal Philharmonic Orchestra, conducted by Efrem Kurtz. Coronet KLC647.

It is impossible to consider La Boutique without mental reference to Decca's historic version dating back to the earliest days of LP.

It was by the London Symphony Orchestra, conducted by Ansermet, and it was in fact the first full length LP I ever heard.

Even now, this new recording isn't so far ahead of it.

The surface noise is lower and there is more presence to the sound, but the bass is not as full or deep.

There isn't as much of the music as on the original disc, nor to my mind has it the same bright air, notwithstanding the fact that it is played at a faster pace.

The presence of Carnaval on the reverse side hardly makes it a competitor of the Decca. The coupling is a good one, for the mood of the music is similar in many ways. Both were originally piano works and the orchestral arrangements are equally successful.

The performances I thought were good but not brilliant. The gay moods haven't the full sparkle I would have liked, the light touches are not really delicate and the romance often studied.

But the only real criticism I have concern the pauses between sections on each side. I don't think many would be interested in picking them out for separate listening. Ansermet's La Boutique showed how beautifully one can lead to the other, and how much the music gains thereby in interest and cohesion.

However, it is a tuneful disc, very well recorded, and it should be popular. It has an excellent surface.

★ ★ ★

PUCCINI.—Highlights from La Boheme with Renata Tabaldi, Hilda Gueden, Giacinto Prandelli, etc., and the Chorus and Orchestra of the Accademia di Santa Cicelia, Rome, conducted by Alberto Erede. Decca LXTA5387.

The recording of Boheme from which these interludes were taken dates back to 1952, and it was probably the first full version to appear here on LPs.

I can still remember the effect it had upon me when I first heard it complete, and I'm sure thousands of others must have been similarly thankful to be freed at last from the intolerable burden of interrupting such uninterruptable music every four or five minutes.

It is probable, therefore, that I am rather biased in comparing it with those that followed, but I would still sooner hear it than any of the others.

Orchestrally, it hasn't the bloom and delicacy of Beecham's version, but I think it has incomparably the best Mimi and probably the best Rodolfo as well.

Above all, it has the ring of youth about it, and a freshness I can't always find elsewhere. The irresistible appeal of Boheme is built essentially on youthful foolishness and tragedy, and well worn or middle-aged voices have no place in it.

I think its drama is the most convincing, too: it flows with a truer sense of theatre, with no suggestion of a concert hall atmosphere.

Excerpts are always hard to manage, but Decca has been wise in taking con-

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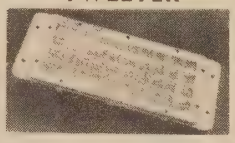

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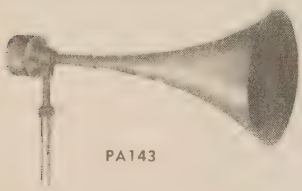
Standard reflex horn speaker for medium distance projection of speech and incidental music.



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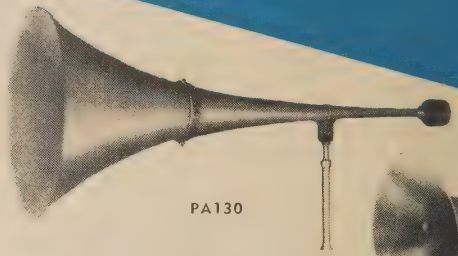

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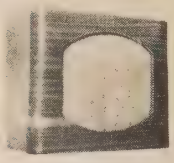
Standard exponential horn speaker for public address where distance projection of speech and incidental music is required.
These flare baffles are for use with 7in and 12in permanent magnet cone speaker units and provide high conversion efficiency



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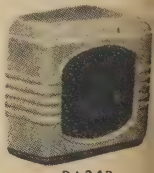

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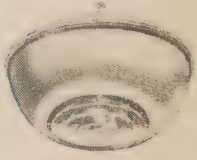

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For overhead mounting this is a surface style unit. 360 degree diffusion over a wide area. In smart styling to suit modern architectural treatments

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For flush mounting, this unit has a recessed acoustic surround which mounts the complete assembly above the ceiling line. 360 degree diffusion

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nuous sections rather than disconnected rias. Thus we get almost the entire st half of Acts 1 and 4 with shorter ections from Acts 2 and 3, including Iusetta's Waltz Song, and the Quartet om the 3rd Act.

In recutting from the original tape, ne surface has been greatly improved. General quality is a tribute to Decca's istinguished engineering—even today no xcuses are necessary.

Failing a complete Boheme this disc an be given top rating. Others will nevitably be compared with it.

★ ★ ★

DELIRIUM IN HI-FI. — Elsa Popping and her Pixieland Band (recorded in France). 12 numbers with Electronic Assistance. Fontana 680 201 TL.

The band starts with fairly conventional arrangements of popular music, ome of which is known to us and some unknown. By means of electronic tricks with tapes, the original is amplified, supported, and even replaced by sections played faster, slower, a small interval behind, backwards, and so on.

Mostly these effects are designed to support the music, not to make a fool of it. They are not to be confused with Musique Concrete, which has no necessary conventional starting point but exploits new sounds for their own value. But some of the techniques are similar.

One ingenious trick is to record a passage for voice, play it backwards, learn this inverted result, and record it that way. Finally the tape is reversed again, so that the singer is back once more, right way up, but with a backwards sound, if you know what I mean.

To me the result is many sided. It can amuse, intrigue and astound you, or you can just enjoy it for what it is — a new kind of pop.

And the recording is fine.

AMPLIFIER RESPONSE, STABILITY AND ALL THAT

(Continued from Page 39)

ings, and on these optional impedances was unstable with added capacitance cross the load. It also oscillated on peaker load and divider network but nly with .47 mfd added. With other alues it was stable on the 15 ohm conection.

All these amplifiers used between 22 nd 28 db of feedback, with No. 2 aving the largest amount.

By way of comparison, two versions f the 17-watt ultra-linear amplifier were ubjected to the same test, the circuit eing the same as that used for "My ersonal Amplifier" and reproduced erewith, but with the addition of a step ircuit at the plate of the first valve s suggested in a recent article, and an olating resistor in the input grid circuit.

As the illustrations will show, the quare wave shape was almost perfect. lost significant is the small change in quare wave response over a wide load ariation.

On a 15-ohm cross-over network, both hese amplifiers were tested at various mes without a step circuit, and showd no oscillation with long speaker leads.

Under these conditions one of them ave an exceptionally fine frequency reponse and a virtually perfect square ave, as all its resonances were small nd very high in the range.

It was flat from 15 cycles to 30 kc, minus 1 db at 65 kc, 2 db at 95 kc, 3 b at 115 kc, 4 db at 145 kc, 6 db at 00 kc, 7 db at 300 kc, 9 db at 400 kc nd 12 db at 500 kc.

No difference could be detected in istening tests either with or without the tep circuit.

Using the step circuit, the first amplier was flat from 15 cycles to 20 ks, minus 1 db at 48 kc, 2 db at 60 kc, 3 b at 75 kc, 6 db at 100 kc and 12 db t 165 kc after which the gradual roll ff continued. It used 22 db of feedback.

The second was flat from 15 cycles to bout 30 kc, minus 1 db at 52 kc, 2 db t 3 kc, 4 db at 85 kc, 6 db at 100 kc nd 12 db at 130 kc, after which roll-ff continued. It used 20 db of feedback.

The only circuit difference was a 2AX7 phase-changer in the first, and a 5L7 in the second, with feedback resistors to suit.

Both amplifiers were completely stable on any kind of resistive or speaker loading, even when feedback was increased to over 30 db. The only sensitivity to oscillation occurred when a capacitance of .047 mfds was connected directly across an inductive load. Values substantially above or below this figure, even when connected across the output on open circuit did not cause oscillation.

From these observations and tests some general conclusions can be made, particularly as they affect the matter of HF stability.

All amplifiers using voice coil feedback are sensitive to some value of pure capacitance connected across the load. This is because the voice coil circuit is part of the feedback loop, and adding capacitance is tantamount to upsetting feedback correction which the designer has been at some pains to provide. Even if no oscillation is present under this critical condition, few amplifiers have a very great margin of safety, and exhibit very severe ringing and poor transient response.

As long as the critical capacitance value is not comparable either with that of long speaker leads, or of a cross-over network, it can be neglected as a factor in practical stability. For instance the oscillograms for the Playmaster taken with various types of resistive and inductive loads, including 30ft of speaker leads, show no suggestion of critical ringing.

On the other hand, at least, one of the commercial amplifiers was obviously not safe in this regard, for the long speaker lead capacitance was enough to make it oscillate under operating conditions.

The more feedback used, the greater the risk of oscillation and the greater is the sensitivity of the amplifier to critical loading. The idea of a 6 db stability margin on speaker load is acceptable, but there is no reason why this figure should have a particular significance.

It is much better to restrict feedback to about 20 db, at which figure most of its advantages are realised, than to risk instability by a design which shows a tendency to ringing or oscillation on any normal load.

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PEOPLE have been asking when twin-channel amplifiers for stereophonic sound will be available. The answer is NOW.

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STEREO 20 is the name applied to the combination of two 12-watt amplifiers on a common chassis.

STEREO 50 is a similar unit consisting of two 25-watt amplifiers on a common chassis.

FOR use with either of the above amplifiers or with two separate power amplifiers, we present the "POINT ONE STEREO" pre-amplifier providing full control over two channels with comprehensive stereo-monaural switching.

ROGERS DEVELOPMENTS have two new products, a stereo pre-amplifier with push-button selection and inputs for microphone, radio, records, tape and also the "Cadet" amplifier.

THE second speaker may present problems, let us help you in your choice. We carry a full range of speakers and enclosures.

RECORD players and pickups for stereo? Certainly, we have a full range covering all types available on the local market, from small player units to the super Hi-Fi class. Stereo cartridges available include Ronette BF40 £4/5/6, Acos stereo £10/17/6, (Diamond stylus), BSR TC8-S (turnover) £5/5/-, and MBH £27/5/- (diamond stylus).

Watch this column each month for the latest Stereo news. Call, write or phone.

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SHORT-WAVE NOTES BY ART CUSHEN

FLASHES FROM EVERYWHERE

STANLEYVILLE, in the Belgian Congo which is broadcasting on 6079 Kc is on the air from 1.30 to 5.00 a.m., according to a programme schedule received by a listener in Cyprus. The station has several vernacular transcription broadcasts and is in French on Sunday and Monday. News in French is heard at 4.00 a.m. and a relay from Leopoldville is carried from 4.45 a.m to 5.00 a.m.

SIERRA LEONE, which has its transmitters at Freetown, advises that they are in operation from 4.45 to 6.00 p.m. and again from 2.45 p.m. to 8.00 a.m daily, except on Sundays, when the afternoon transmission is not released. The station uses 3316 Kc and the power of 5,000 watts into a single wire dipole antenna. As the present location on the top of a hill does not allow for expansion of larger aerial systems, the transmitter and aerials will be erected at a new location when multi-element aerials will be put into service.

The transmitter power may be increased to 10,000 watts and a number of new and unspecified frequencies also put into service, to give better coverage in the various sunspot cycles, throughout Sierra Leone. The station regrets that due to limited staff and the hundreds of reception reports received, the station does not now normally reply to listeners' correspondence.

SUDAN has been reported by New Zealand listener Dick Pollard on 5040 Kc and this new frequency does not appear to give better results. The old outlet of 5010 Kc was far more noisy where morse interference was severe, and the new channel has not this trouble, but interference from a Russian transmitter on 5045 Kc.

LEBERAN, which has been reported as vacating the old 15110 Kc frequency, has been heard in England on 15135 Kc with news in French at 7.00 a.m.

GREENLAND, a country which is seldom reported on the short wave frequencies, is being heard in Europe from midnight to 12.50 a.m. on 7570 Kc. The station, in verifying a report, gives this as the only schedule for the station, which is broadcasting from Godthabb.

HAITIAN station at Cap Haitian on 6195 Kc, now operates with the power of 540 watts. The station is on the air from 9.30 to 10.00 p.m. and from 8.15 to 9.00 a.m., but a change of frequency is anticipated to avoid interference from Radio Haiti, which operates on 6200 Kc.

A further new missionary station will be on the air in Haiti, using 4VI with 1600 watts and 4VE of 250 watts, and these stations are located in Cayes.

FAR EAST BROADCASTING COMPANY in Manila, which we reported in last issue as testing on 11920 Kc, has also been authorised to use 15385 Kc. The station is being provided with these new frequencies for 50,000 watt transmission and the old frequencies as used at present with 10,000 watts will be kept in service on this lower power.

HONDURAS has a new station using the call-sign of HRRH and on 9541 Kc. The station has the slogan "La Voz de Occidente" Santa Rosa de Copan, and the station had been heard in the United States during our afternoons. HYDRABAD is a new Indian shortwave station which we have been hearing with English news at 1.30 a.m. at good strength. Information from the station is to the effect that broadcasts were commenced on July 15. The station is on the air 11.20 a.m., 1.30 p.m. on 7140 Kc., 5.00 to 8.45 p.m. on 9720 Kc., 10.00 p.m. to 3.00 a.m on 4988 Kc. The station on Sundays continues to 3.30 a.m. and on Monday sign-off is at 2.30 a.m.

COLOMBIAN station Radio Nacional at Bogota is at present operating on two frequencies, 6015 and 6185 Kc. The latter frequency is actually scheduled as 6200 Kc. The stations operate from 10.10 p.m. to 3.00 p.m. A session of English is by Radio is released on Mondays and Saturdays at 10.15 to 10.30 p.m. Another well-known Colombian station is Radio Sotatenza, which has now dropped the frequency of 3250 Kc and is now operating only on HJGC on 5070 Kc. The station opens transmission at 8.45 p.m. and the programmes are mainly religious.

CUBA is scheduled to operate a new station using the callsign COCA. The station has been assigned the frequency of 2440 Kc, and uses the power of 1000 watts. The station will be located at Calle 25 162, Vedado, Havana.

NIPPON Short Wave Broadcasting Station in Tokio, the only Japanese commercial station operating on shortwave, has recently increased its schedule and now is on the air 6.30 a.m. to 1.25 a.m. and uses JOZ (3925), JOZ2 (6055), and JOZ3 (9595). The station has discontinued its English newscasts and has no program in English at present.

SAIGON NOW USING 6015Kc.

Reception of English broadcasts from Radio Saigon are being received during the early evenings, originating from the South Vietnam capital.

MEMORIES of the old broadcasts to the South Pacific from Radio Saigon when under French control will be revived in the session heard from 6.30 p.m. each evening. The station is using the frequency of 6015 Kc, which is giving only fair reception due to jamming and the close proximity of Voice of America transmissions on 6020 Kc.

The station has a request session of popular music to 8.00 p.m., and identification is given each 30 minutes, reports Eng. Strange, of Harwea, N.Z.

The station announces as VTVN, "The Voice of Free Vietnam," and should not be confused with the Voice of Vietnam which operated from Hanoi in the Communist North Vietnam.

Further observations disclose signals are best shortly before 8.00 p.m. when the program of requests consists of popular American recordings, with announcements by a lady speaker.

The station concludes soon after 8.00 p.m. this English period of light music and asks listeners to tune in the next afternoon. Following a short musical item a broadcast in Vietnamese is released and signals during this period of the transmission reach good strength. Though the frequency is subject to interference the program is of enjoyable quality and, as the evening progresses, the side interference is gradually lessened

News from readers should be sent to ARTHUR CUSHEN, 212 Earn Street, Invercargill, N.Z. All times are Australian Eastern time.

TAIWAN BEAMED TO SOUTH PACIFIC

THE announcement that The Voice of Free China would shortly operate a service for listeners in Australia and New Zealand, was made some months ago, but cabled advice of the start of the service has been received by Kevin Dunham. The transmissions are reported to be in service from 4.15 to 4.45 p.m., and the station was to use 7230, 9575, 11.815 and 15.345 Kc. The station has not been heard in this area at this time. It would be better for the Taipeh station to beam its present English programme at 8.05 p.m. to Australia and New Zealand, on the frequencies mentioned above, as well as to Japan and Korea as at present. This is a much more suitable time for reception here and the transmissions would be received much more reliably throughout the year

LAHORE, which broadcasts from Pakistan, has a new schedule, reports World Radio Handbook. The station is now broadcasting 11.30 a.m. to noon on 4807 Kc., 6.30 to 8.30 p.m. and 9.30 to 1.30 p.m. on 7225 Kc. 11.45 p.m. to 3.00 a.m. on 4807 Kc. The Dacca station in East Pakistan is on the air 11.00 a.m. to 1.00 p.m. on 5980 Kc., 4.00 to 5.30 p.m. on 9614 Kc., 9.00 to 11.00 p.m. on 7140 Kc., and 1.15 a.m. to 1.30 a.m. on 5970 Kc. Special transmissions from West Pakistan are on the air 1.45 to 2.00 p.m on 17890 Kc.

ANGOLA station Emisora Official, which broadcasts from Luanda, is now using 17795 Kc. to replace 11862 Kc., while a 3000-watt transmitter on 6025 Kc. has been put into service. Both stations are on the air from 4.30 to 8.30 a.m., also 9765 and 4955 Kc. also carry the same transmission.

BRAZILIAN station Radio Bibrio da Manha operates from 7.00 p.m. to 1.00 p.m. on 9675 Kc., when the call is ZYI29. The address is Caixa Postal, Postal 331, Florianapolis, Santa Catarina and the station verifies by letter.

IVORY COAST has added a new frequency in the 41-metre band, and this one uses 7149 Kc., with 1000 watts, while the transmissions on 4940 Kc. uses 10,000 watts. The station on the latter frequency has been heard opening at 4.30 p.m. and again at 5.00 a.m., when they have had a news session in English.

CKNK TO SOUTH PACIFIC

FOLLOWING the success of the transmissi on CKNK on 11.945 Kc during the Co monwealth Finance transmission this frequency now used in the Australasian service. The form frequency of 5970 Kc station CKNX was too by in frequency to maintain a good service to Au tralia and its replace should give good results this area. The transmission is also carried CKLO on 9630 Kc, and the broadcast is on th air from Montreal daily from 6.30 to 7.05 p.m

READER REPORT

EUROPEAN signals are reported from Gerlia Albeck, of Neutral Bay, N.S.W., who hearing RIAS on 6005 and NDR, Hamburg 6075 at 4.00 p.m. Both stations use 20 kw a the signals fade out after 8.00 a.m. Paris broa casts in German on a frequency of 6040 Kc 4.00 a.m.

Tangier is heard with Music U.S.A. progra from 8.00 a.m. when using 9615 Kc, but aft 8.15 a.m. some interference has been noted fro VLX9. Prague has been heard on 17.815 Kc wi the North American service in English at 3.0 to 3.30 p.m., the service is also carried on oth frequencies in the 19 and 25-metre bands

TESTS FROM RANGOON

FOLLOWING on our reception of Rango with broadcasts from 11.00 a.m. to 12. p.m. on 21.575 Kc, Kevin Dunham, of Narand N.S.W., has reported other frequencies in s vice. A test broadcast from 7.00 to 8.00 p with the target area of Australia, is using 21.5 Kc in English. The station has also been hea on 21.725 and 21.420 Kc at various times broadcasts are from 11.00 a.m. to 12.30 p.m wi English at noon, and also 3.30 p.m. to 5.00 p in Burmese and English from 5.00 p.m. Sign have been heard with two frequencies, b strong on 21.575 Kc, suggesting the use of low powered transmitters on 21.420 and 21.720 K The normal evening service of the Burma Broa casting Service has also been heard on the channels from 9.00 p.m. to 1.15 a.m

BROADCASTS FROM WELLINGTON

THE extension of broadcasting times has be announced by Radio New Zealand, and station now has a service from 3.00 a.m. to 9 p.m. The transmissions to the Pacific area now released from 3.00 a.m. to 3.45 a.m. 11.830 Kc, 5.00 a.m. to 3.45 p.m. on 15.280 K 4.00 to 6.45 p.m. on 6080 and 9540 Kc Australia the service is 6.00 a.m. to 8.30 a.m. 11.780 Kc, 8.45 to 3.45 p.m. on 15.220 Kc, 7 to 9.45 p.m. on 9540 and 11.780 Kc

SOMALI ON 9666 Kc.

THE announcement that Radio Somali moved from the 7126 Kc frequences to 9 Kc, will not be welcome news in this ar as the chances of hearing this unusual stat will be much more remote. Broadcasts are n carried on the announced frequency of 9666 and these are on the air from 12.30 to 2.18 a The broadcasts from Radio Somali originate f Hargeisa, and use the power of 5000 watts. F grammes in Somali are to 1.15 a.m. and Eng is broadcast for the last hour of the tra mission, with news at 2.00 a.m. The station dress is P.O., Box 14, Hargeisa, British Som land

AMMAN TO 100 KW

BROADCASTS from Jordan from the trans ter at Amman are expected to be m this month on new high powered equipm The Hashamite Broadcasting Service will be the air from 2.00 p.m. to 8.00 a.m. and transmitters of 100 Kw in the 30 metres band 7 watts in the 25 metre band, and 5 Kw in the and 49 metre bands. On medium wave 5Kw 1437 Kc and 100 Kw on 577 Kc.

The frequencies which the station will use not known, as at the moment the station using a restricted schedule in the 49 metre b Broadcasts from Jordan should be well rece on the new transmitters. It seems a coi practice in the past few years from many o Middle East countries to put in high pow equipment, and Cairo, Baghdad, and now Am are all new transmitters of 100,000 watts

THE HAM BANDS WITH BILL MOORE

Radio amateurs throughout the world have been co-operating making VHF signal observations in support of the IGY ionospheric investigations. The data being accumulated is being sorted and recorded for analysis at a later date.

I.G.Y. propagation research by radio amateurs in the U.S. and overseas is continuing. The chief job of the A.R.R.L.'s observers operating in many countries is the reporting of ionospheric working with DX stations and signals heard on bands 50 m/cs and above. The recording centres around a core of 550 amateurs located in 60 countries. Individual contributions to the scheme have been remarkable: some amateurs ever seem to work or even eat.

Amateur employees of one firm were granted permission to run a 50 mc beacon 24 hours a day on the company's property.

During the sporadic E season reports reached a peak of 30,000 a month and data processing was a very complicated and busy affair. The reports as received are examined for propagation type and accuracy and then transcribed on to special forms. Data is coded and details arranged in systematic form suitable for punched card presentation.

Before the cards are punched, locations Latitude and Longitude of stations concerned are listed.

Each worked, heard, negative and beacon report rates a card of its own. Each card shows, where applicable, date, beginning and ending time, calls and position of stations, antenna bearing, signal report, type of propagation and type of report.

After sorting in chronological order, the cards find their way to the Air Force, Cambridge Research Centre, where they are put through a digital computor.

The eventual listing of the information obtained is sent to the I.G.Y. World Wide Data Exchange Centres.

The true value of all the information gathered will not be actually known for many years. The I.G.Y. is essentially a period for collecting data. Detailed study of the material gathered will take a long time.

It has been the aim of the A.R.R.L. Propagation Research Project to list amateur observations in a manner most useful for scientific study.

F2 layer skip and MUF observations will provide interesting checks with predicted and measured figures.

Transeonatorical Scatter on 50 mc/s originally observed by amateurs in North and South America was thought to be peculiar to those continents. Amateurs during the I.G.Y. have shown similar conditions exist between Africa and Europe and Australia and Japan.

It is considered, too, that TE may have some connection with the World Record Contacts between Japan and South America.

Amateur observations on beacon stations in CE and OA operating close to 50 mc/s have provided a wealth of information. The above are only a few phases of amateur co-operation.

The contributions of amateurs in these propagation studies are being received with acclaim from scientific bodies.

Country conventions in holiday weekend

THE two N.S.W. conventions run over the Six-hour Day holiday weekend in October were exceptionally well supported. The elements were inkind to amateurs who congregated at Canberra but those at Newcastle experienced excellent weather.

The Canberra Radio Society acted as hosts for the S.W. convention and the event commenced with a tour of Canberra on the Saturday afternoon.

The official dinner commenced at 6.30 p.m., 77 persons in attendance.

Ken Finney, VK1AIL, acted as M.C., and acting president of the society, Mr [illegible] welcomed the many visitors. Zone officer Jim Edgar VK2AIO, in speech followed and he introduced the Federal Member for the A.C.T., Mr Jim Fraser, who spoke on many phases of amateur work. The final speech of the evening was made by the State president, Perc Healy, VK2APQ.

After the dinner, the party returned to the society's club rooms, where films were shown, a radio amateur hour conducted, and a Dutch auction held to augment the I.T.U. fund. Some £30 was raised towards the delegates general expenses.

Sunday was spent in the field, when amateurs competed for the many prizes.

In Newcastle 51 members and guests attended the Hunter branch's annual dinner held under the chairmanship of Lionel Swain, VK2CS. Mr Allan Fairhall, VK2KB, M.H.R., Minister for the Interior and Housing, proposed the toast to "Amateur Radio," offering members excellent advice on many matters affecting the movement.

Divisional vice-president, Max Sobels, VK2OT, responded on behalf of the W.I.A. and amateurs in general.

Guest speaker for the dinner was John Moyle, VK2JU, who provided an interesting insight into new horizons and things to come that will make an impression on amateur radio.

Sunday was spent in Blackalls Park, where the field events were followed and amateurs competed in scrambles, hidden transmitter searches, etc.

The Sunday VK2WI broadcast was presented in part from VK1ACA, the Canberra society's transmitter, by Perc Healy, VK2APQ.

Mr Fraser, M.H.R., gave his impressions of the function over VK2WI. He is co-patron with Mr Fairhall of the society.

The second section was provided from Newcastle and presented by Max Sobels, VK2OT. It was radiated from Barry Lloyd's VK2ZDI station on 144 mc/s and relayed on 7146 kc/s by Bob Godsall, VK2ARG, at Palm Beach.

A full resume of the VK2WI Sunday broadcast can be held each Monday evening at 8 p.m. The session is on 7146 kc/s from VK2AWX official station of the Hunter branch. The broadcast also carries news of local affairs.

Fund grows for delegate to Geneva

THE I.T.U. Fund sponsored by the W.I.A. to send a delegate to next year's Geneva Conference representing amateurs in Zone 3 is being well supported.

Additional moneys are still required to ensure the accredited delegate can attend for the required period of time and report back to the individual divisions of the institute on his return.

The target set by the Federal Executive of the W.I.A. for the end of the year is £2,500 and it is hoped that all amateurs, members or not, appreciate the necessity of effective representation.

The demand for extra frequency assignments, by other services will be at high priority and amateurs must take every precaution to see the movement's views and requirements are brought forward.

Donations should be sent to the Federal Secretary, W.I.A. Box 2611 W. G.P.O., Melbourne, or via your State division.

THE N.S.W. VHF and TV Section's 144 Mc Convertor Project was in the final stages in early October. The proto-type had been tested and kits of parts, complete with prepared chassis, were being dispatched to country members.

The section in it's endeavours to popularise and populate the 144 Mc band started the project and members have been very active in preparing the equipment. As a result a further increase in 144 Mc activity in country areas will undoubtedly be noted.

NORM BURTON, well-known VHF enthusiast, will present a series of lectures on Superhet Receivers to members of the N.S.W. W.I.A. S.W.L. Section.

The section meets at the Railways' Institute, Castlereagh Street, Sydney, on the second Friday of each month.

Under the chairmanship of Barney Smyth, W.I.A. L2001, the section invites S.W.L.s in Sydney and its surrounds to attend the meetings. Inquiries regarding activity could be directed to the secretary, Barry Cartwright, W.I.A. L2002, at the institute's Box 1734, G.P.O., Sydney.

Any S.W.L. associate member may join the section and just on 60 official listener numbers have been issued since the opening of this sphere of N.S.W. Institute activity in April.

THE correspondence course for the Amateur Operator's Certificate of Proficiency conducted by the N.S.W. Division has received remarkable support with students participating from all States of Australia (including the Northern Territory), Papua and Lord Howe Island. Inquiries regarding this course can be directed to the Secretary, N.S.W. Division, Box 1734, G.P.O., Sydney. During the last two years the amateur population is on the increase in Australia after a rather quiet period in the early 1950s.

C.W. On VHF Bands

THE F.C.C. have produced the proposed rules to cover exclusive C.W. segments on 144 and 50 mc/s bands. The first 100 kc/s will be set aside for code operation.

These new segments would allow serious VHF operations to perform more effective work in weak signal communication. C.W. has a tremendous advantage over telephony in weak signal working. All VHF operators appreciate this fact when they endeavour to increase the range of their station under difficult conditions.

Much more DX could have been worked during the last F2 50 mc/s season only for the number of stations using telephony on the low-end of the band.

50 mc/s is only open for extreme DX working for a short period of each month, sometimes for only a relative few minutes each day. It is essential that the recognised calling frequencies should be kept as clear as possible for marginal conditions.

Prospects For DX

A RATHER gloomy picture for DX working in the coming years has been painted in an article in British Communication and Electronics.

It is pointed out that there appears to be a tendency for cycles of low sunspot maximas to follow a series of high sunspot maximas cycles. On this score it is suggested that the maxima of the next one or two cycles will be very much lower than the one we are currently enjoying. It is a possibility that radio services may be faced with several decades of what from a radio viewpoint could be considered virtually sunspot minimum conditions. If such a stage is reached the 28 and 21 mc beams can be dropped and thoughts given to a 7 mc array or even some arrangement for 3.5 mc/s.

Novice Stations

MANY novice class licensees in the U.S. have written expressing thier thanks to overseas stations who contact them. Many of these stations spend hours sending slowly and sorting out the KN's and WV's often to give them the thrill of their first DX. Well-known DX-er, CT1JL, can be heard practically daily on 21 mc/s working the novices. A number of these licensees are working towards their DXCC. using beam aerials, but more often than not they qualify for a higher class licence before reaching the century.

K6XBV rates 117 countries worked and 93 confirmed is the forerunner for a DXCC. He is now licensed to K6ZBV.

Honour Roll Scores

JOCK WHITE, XL2GX, has jumped well up in the ARRL's DXCC honour roll. He now runs in equal fifth place with two W8's and lists 275 countries confirmed. Don Wallace, W6AM, is still in first place with 270 countries accepted. ZL1HY is also well up with 271. There are 24 stations now grouped between 279 and 271 confirmed.

PY2CK still leads the telephony gang with a tally of 273.

New countries are being listed rapidly and Goat Island (in Sydney Harbour) must rate a chance of making the list one day.

Most of the DX fraternity react to many of the current listings, especially those around home when you can assess their governmental and geographical positions. Still, to run out of new countries would be disastrous to the current trend of DX working—much interest would be lost.

In September and early October the 21 mc band really showed its worth with S7 to S9 signals appearing from all continents. If ionospheric disturbances do not intervene, the band should provide some outstanding DX during the VK/ZL DX contest. It held up during the telephony section at one stage around 1700 hours EAST all continents were audible, the band just a mass of S8 to S9 signals.

VP8 Activity

ACCORDING to Les. VP8CR, Coatesland, Antarctica VP8 activity is mainly as follows: John, VP8VY, also operates from Coatesland, while Colin, VP8CC, is active from Graham Land. All mainly use 21 mc/s CW. VP8CQ and VP8DL can be heard from the South Shetlands. A number of VP8's are located in the South Orkneys as is also LU1ZA. Main activity in the Falkland Islands is on 14 mc telephony with VP8DS, 8DW, 8CV and 8DE the most prominent.

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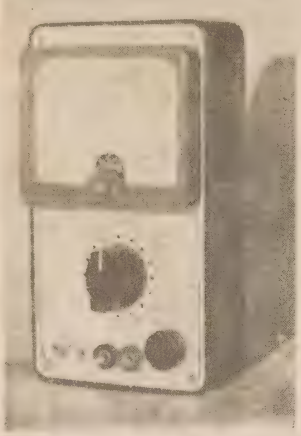
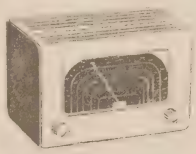


TESTER BOY MULTIMETER

The Tester Boy Multimeter is ideal as a portable instrument for radio and TV servicing, is ideal for the hobbyist, motor mechanic, etc. Dimensions are 6½ inch long, 2 5-8in wide and 2 5-8in deep.
Weight 1lb 13oz.
Ranges as follows:
Volts AC and DC 2.5, 10, 50, 250, 500, 5000.
Resistance 0-10,000 ohms, 0-100,000 ohms and 0-1 meg. ohms.
Decibels minus 20db to plus 10db, 0db to plus 56db.
By referring to a chart up to plus 56db may be measured. The case is black bakelite with a metal panel and 3in meter. Test leads are stored in the leather carrying case that holds meter and leads. Sensitivity of meter is 1000 ohms per volt.

Price of this unit is £7/10/-



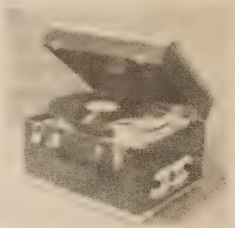
ONE VALVE KIT SETS

for the learner

Although this little set is easily built it looks like a factory job, complete with chassis covered with burgundy leatherette and the dial has all Australian stations marked in different colours. Parts are mounted on a wooden baseboard and anyone can build it if they can use a soldering iron. Circuit diagrams, wire, solder, etc., supplied. Price of complete kit of parts including Valve, Headphones and Batteries.

Normal price £8/5/-

Our price £5/19/6



RECORD PLAYER AMPLIFIER

Very compact and lightweight This uit combines a 4½ watt amplifier with two inputs, one for the built-in 3-speed Philips record player and one for a crystal microphone. Each input has its own volume control. Also two outputs, and one for a separate extension speaker. Also an on-off switch and tone control is provided. The cabinet is finished in two-toned leatherette. Ideal for parties or for playing records in the home.

Well worth 35gns.

Price only 27gns.

6in extension speaker in leatherette covered box worth £5. **Our price 69/6.** Crystal microphone to match this unit, **45/.**

4-speed Record Player in leatherette covered case with automatic stop, turnover head with crystal cartridge and 2 sapphire needles, plays standard and microgroove recordings. All colours available. Worth 19gns.

Price £13/19/6 each.

SPRING GRAMOTORS. wind-up type suitable for replacement in portable gramophones, etc. Complete with turntable and fittings.

Price only £1/15/.

3-speed Record Player Units consisting of motor and turnover head crystal pick-up. 2 sapphire needles, ideal for both standard and microgroove recordings automatic stop, english make.

Price only £9/19/6 each.

4-speed Gramo Motors to operate from 230 volt AC supply. Each has control knob with 16, 33, 45 and 75 r.p.m. positions and on-off switch Ideal for playing all types of recordings. An excellent job, these are brand new and boxed.

Price only £5/10/.

4-speed Record Player Units consist of motor and turnover head, crystal pickup with 2 sapphire needles, ideal for playing microgroove and standard recordings. Automatic stop, English make.

Price only £10/19/6 each.

Magnetic Pickups — English made with bakelite arm for 78 r.p.m. records, lightweight.

Price 7/6 each.

★ SPECIALS ★

1. Philips Transistors available in the following types:
   OC44 ... £1/18/
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   OC71 ... £1 7 1
   OC72 ... £1 13 3
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4. Single earpiece as supplied with Japanese crystal sets, etc. Brand new and boxed only **12 6 each.**

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   10 x 6 x 2½ ... 12
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   13 x 7 x 2½ ... 14
   13 x 10 x 2½ ... **17/6**
   17 x 8 x 3 ... **22/6**
   17 x 10 x 3 ... **25/6**
   17 x 12 x 3 ... **26/**

6. **Germanium Diodes** English make, brand new and perfect, ideal for use as crystal detectors, rectifiers, etc., in radio and TV sets **Price only 3 11 each**

7. Condensers of assorted types as listed, All are in new condition and guaranteed.

Capacity MFD	Voltage	Type of Condenser	Price
.00017	2000 wkg.	Mica Block	3/-
.00017	4000 wkg.	Mica Block	4 -
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.005	2500 wkg.	Paper Block	2 -
.01	5000 wkg.	Oil Filled	4 9
.01	750 wkg.	Mica Block	1/-
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.01 +-.005 +-.005	600 wkg.	Paper Block	1 6
.015	2000 wkg.	Mica Block	2 9
.02	300 wkg.	Paper Block	9d
.02	1000 wkg.	Mica Block	2 -
.02	1000 wkg.	Mica	2/-
.025	2000 wkg.	Mica Block	3 -
.1 +-.1	1500 Test	Paper Block	1 -
.1	1000 wkg.	Mica Block	2 6
.1	4000 Test	Paper Block	3 -
.1	1500 wkg.	Paper Block	1 -
.25	400 wkg.	Paper Tubular	6d
.25	600 wkg.	Paper Tubular	9d
.25	1500 Test	Paper Block	9d
.25	8000 Test	Paper Block	3 9
.5	200V wkg.	Paper Tubular with braid leads	1 -
.5	400 wkg.	Paper Tubular Metal Clad Vert. Mtg.	1 3
.5	750 wkg.	Paper Block	2/-
.5	1000 Test	Paper Block	1 9
1	500 Test	Paper Block	1 6
1	500 wkg.	Paper Block	2 6
2	800 wkg.	Paper Block	3 3
4	350 PV	Electrolytic	1 -
5	400 wkg. 110AC wkg.	Paper Block	4 -
3 and 5	400DC	Paper Block	5 -
8 x 8	525PV	Multi Electrolytic	3 6
25	40PV		
10	40PV	Electrolytic	1 -
25	40PV	Electrolytic	1/6

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WIA Membership

MO amateurs and radio enthusiasts the advantages of W.I.A. membership is becoming increasingly important. As well as ensuring that the W.I.A. can most effectively represent the movement, there are many privileges gained by joining.

The Institute operates divisions in all States of the Commonwealth and in Papua/New Guinea and membership is available to residents of any of these.

Federally the Federal Executive, located in Melbourne, operates under the direction of the Federal Council. This executive covers all matters of a Federal nature and affords liaison with similar bodies overseas.

Membership is available in two grades: Full and associate. Full membership is granted to holders of amateur licences or their equivalent. Associate grade may be taken up by short wave listeners or radio enthusiasts.

Members receive monthly the W.I.A. journal, "Amateur Radio," together with QSL service, technical lectures, disposals equipment, technical library facilities, etc.

Inquiries regarding membership should be addressed to the secretary of the appropriate address shown.

New South Wales: Box 1734, G.P.O., Sydney.
Victoria: C.O.R. House, 191 Queen Street, Melbourne.
Queensland: Box 6381 G.P.O., Brisbane.
South Australia: Box 1234K, G.P.O., Adelaide.
Western Australia: Box N1002, G.P.O., Perth.
Tasmania: Box 371B, G.P.O., Hobart.
Papua/New Guinea: P.O. Box 204, Port Moresby.

NSW Doings

RECENTLY retired from the position of treasurer of the N.S.W. Division of the W.I.A. is Ced Smith, VK2CD ex VK3QG. Ced took over the treasurership at a difficult time and with the phenomenal growth of the membership since then was kept very busy during his term of office. His experience in the field will be missed.

Newcomer to this office is Bob Luther, VK2ZEL. Bob is well qaulified to fill the position, his life's work is in a similar field.

Amateurs will wish him well in his work.

Membership of the N.S.W. Division missed the 3000 mark by 15 at the end of September, the prophecy of last month should rectify itself by the time these notes appear.

Members and visitors totalling 117 attended the September general meeting of the N.S.W. division. It was the largest assembly for a number of years. Lecturer was Maurie Finlay VK2PW, and the subject 7 Mc Mobile Equipment. Maurie displayed a complete Mobile Station the transmitter VFO and crystal controlled, a crystal locked convertor and modulator. The transmitter was so designed that the VFO could be checked against the crystals for frequency measurement.

Mobile operation on 7 Mc is on the increase and this summer should see many more stations in the field.

Visiting country amateur Geoff Page, VK2BQ proved the vote of thanks to the lecturer.

Discussed at the meeting was correspondence that had passed between President Perc Ha... VK2APQ, and the N.S.W. Minister for Education, Mr. Heffron. The president pointed out to the Minister the courses that the division conducted covering technical requirements for obtaining an amateur licence, and the desirability of interesting young people in radio as a pastime.

It was suggested that amateurs connected with education matters should publicise the fact that the division provided both class and correspondence instruction on technical requirements for the amateur licence.

Maritime Mobile

IT is a pity that all maritime mobile stations are not forced to use the suffix MM after their call sign. LU zero stations all appear to be mobile marine and use no suffix. The result—quite a deal of time can be wasted waiting for identification. Normally with zero as part of the callsign South American stations are out of one of the outlying islands and generally classified as a new country.

Personal

ERIC FERGUSON, VK3KF, has been in the news overseas for his RTTY working and talked up the first W/VK contact using that mode of transmission. Eric is often to be heard on 21 mc/s and keeps RTTY schedules with W stations. In his spare time he works them on CW.

Jack Turner, VK2AJO, is another amateur in the country assisting the W.I.A. in a job that would normally fall to the lot of some city member. Jack is producing tracings of circuits of a variety of equipment in use at VK2WI. It is very necessary to record the modifications that have been carried out to allow possible servicing at a latter date.

The story of the month concerns a Sunday army signals exercise that finished as a parade at VK2WI, Dural, and a conducted inspection of the installation. It is a pity the ramifications of the exercise cannot be retold but if you can get it recounted it is well worthwhile. The ultimate outcome, prospects of a few new members for the W.I.A.

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LOWEST PRICE OF ANY HI-FI SPEED RECORDER EVER ACHIEVED IN AUSTRALIA

You cannot miss this opportunity if you contemplate buying a tape recorder.
ALSO AVAILABLE: COLLARO DECK, single or with Pre-amplifier only (INCORPORATING THE AUTOMATIC 3-SPEED COMPENSATION) and Magic Eye level indicator, with or without power supply. Compensation and Oscillator Coils for this deck.

"STUDIO" 3 Speed 7/8, 3¾, and 7½"/sec. 3 motor. 2 or 3 Heads, single ended, 4-watt or push pull 10-watt. Magic-eye or Meter Level Indicator, Place finder. Single Knob Control 15"/sec optional.

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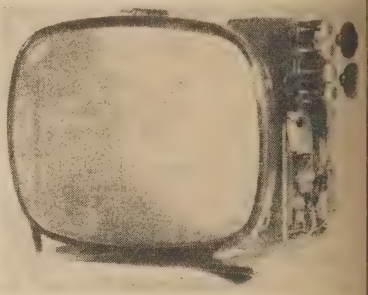

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6 Valve 6V 10 watt, £18/15/

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7 Valve 12V 25 watt, **£24/17/6**

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7 Valve 12 x 240 12 watt, **£21/15/**

7 Valve 12 x 240 25 watt, **£29/7/6**

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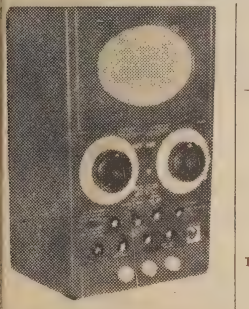

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£2/5/-

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v, 420 watt Prefocus Globes. 7/6

NEW C.R.O. TUBES

Suitable for TV Pic. Tubes.
CR 139A 2¾in £1 10 0
CR 138A 3in £1 7 6
CR 97 6in £2 17 6
1 £2 10 0
3. Delivery Aug., 1in
Min. CRO £1 12 6
P7 Flying Spot, 5in .. 17 6
V112 £1 5 0

NEW 3BZ TRANSMITTERS

v operation, 2 to 10 Megs. Air tested. Perfect order.
mplies with P.M.G. requirements. r small ships, bushfires and all her services.
COMPLETE WITH 1 CRYSTAL.

£32/10/-

TRANSCEIVERS

o. 11 less valves and meter. £3.
o. 11 including valves and meter, £4/10/-.
o. 19 less valves and meter, £3.
o. 19 including 15 octal valves and 500 micro amp. meter, £5/15/-.
M.: All these units are in excel- ent condition. For original use parts or conversion.

WALKIE TALKIE

American No. 536 Transceivers. Complete with Valves.

£4/17/6

NEW HIGH IMPEDANCE HEADPHONES

£1/10/-

Postage 2/6.

AR8-AT5—COMPLETE STATION

AIR TESTED

Transmitter-Receiver Aerial Couple Cables. Plugs. Phones, Mike. 1 Crystal to desired Frequency. 24v. Power Supply and Circuits of 2 units.

GUARANTEED IN PERFECT ORDER.

£62/10/

Other voltages available.

12V Lighting Plants

Johnston 300 watt direct coupled in 1 H.P. petrol engine. Tested. Perfect order.

£36

NEW VALVES

217C	10/	AV11	3/9
12C8	12/6	6K7	5/
6J8	17/6	12SJ7	12/6
VT501	12/6	12SK7	8/
2D21	15/	12SL7	12/6
6L6	20/	39/44	10/
1C6	12/6	46	12/6
1J6	12/6	47	12/6
1P5	2/6	78	12/6
6A6	12/6	828	£2/10/
3A4	15/	843	£1/10/
3B7	10/	957	10/6
3D6	10/	1625	£1
6AG5	7/6	1629	10/
6AM5	15/6	4307A	10/
6AM6	17/6	1619	£1
6H6	2/6	2050	£1
5Y6	15/	9001	8/6
6J7G	7/6	RK75	10/
6N7	10/	VR75/30	15/
12A6	2/6	RK48A	£3
2A3	£1	954	7/6
KTW62/6U7	7/6	VR105/30	15
1M5	7/6	1C7	2/
1D5	7/6	5A5	7/6
CV6	3/6	7193	3/6
6F6	12/6	6G8	15/
VR65A/SP41	2/6	6B8	12/6
KT66	27/6	807	15/
806	£3/10/-	EL3NG	12/6
6X5	10/	83	10/
6V6	12/6	EMI	12/6
1Q5	2/6	866A	15/
811	10/	6AC7	2/6
6E5	12/6	EF50	2/
6BM8	17/6	100TH	10/
12K8	12/6	5R4GY	£1
1T4	10/	6AJ5	9/6
3S4	10/	EA50	2/6
1L4	5/	1K5	2/6
VT502	12/6	6C4	7/6
6SL7	15/	6SN7	12/6

NEW AIRCRAFT AIR COMPRESSORS

Complete with Filter. Hi-speed, Ball-bearing. 2 cu. ft. per minute. Ideal for small spray gun, etc.

£3/17/6

DON 8 TELEPHONE WIRE

2 mile Drums.

£2/-/-

1 mile drums £1.

NEW

240V AC, 1/20 h.p. Motors

Series wound. 7,000 r.p.m.

£2/17/6

NEW TRANSFORMERS FERGUSON VIBRATOR TRANSFORMERS

300 x 300 100 6v £1 17 6
325 x 325 125 12v. £3 12 6

Inverter Transformers

6v., 240v. 40 watt .. £3 7 6
12v., 240v. 60 watt .. £3 7 6
32v., 240v, 600 watt .. £3 7 6

C.R.O. Transformers

350 x 350 extended to 1000v.
6.3v., 6.3v., 215v., 4v. £4/5/-.
Postage: N.S.W. 5/- Interstate 7/6.

Power Transformers

285 x 285 60mA £1 17 6
285 x 285 80mA £2 7 6
285 x 285 125 mA £3 5 0

TV Power Transformers

240v. A.C.
295 x 295 300mA £6 15 0
295 x 295 400mA
12 amp Fils £8 5 0

Transmitter Power TX

240V-50V Primary.
1500 x 1500 750MA .. £10 10 0
750 x 750 750MA .. £7 10 0
240—110V 2KVA .. £10 10 0
300 x 300 500MA £4 15 0

RELAYS

6v. 3-Pole Miniature 15/
1700 SPDT 7/6
1300 SPDT 7/6
500 x 500 SPDT 7/6
12 volts DPDT 5 amp £1
12 volts DPDT 12/6
11 volts A.C. £1
Hi-speed Polarised relay. £2/10/-
400 ohm 12/6

½in Square Section DURAL TUBING UP 24 12ft lengths, 1/- per ft.
Hi-lo Phono Transformers .. 4/6
Spirit Level Bubbles, mounted. 4/6
Canadian Signal Lamps 7/6
Hi-voltage Lead-thru Insulators, 1/6 each; 15/- doz.
Hydrometers, Battery Testers 5/9
Torches, 2-cell, Focusing 6/9
Multi-Strand 4-core Cable. yard 1/-
100 yards £2/17/6
Tx Var. Condensers, 300 pf. £1/5/-
100 pf. £1/1/-
60 pf with Vernier £1/1/-
30 pf. 10/-

NEW AMERICAN

HI-FI HEADPHONES LIGHTWEIGHT PADDED UNITS

£1/17/6

Used Headphones, as above Listed. Perfect order.

£1/7/6

Postage 2/6.

NEW Indicator Unit

for that C.R.O. Project. 8 valves, VCR139A CR Tube. Cabinet Socket Mount for Tube Pots, etc.

£3/10/-

AIRCRAFT GENERATORS

12v. 500 watts.

£5/10/-

New Smith Aircraft CLOCKS

8-day movement. Cost Govt. £28.
2¾in £4/15/-
2¾in with sweep hand .. £5/15/-

New Coils and Intermediates

Standard or miniature to suit all valves

Coils B/C 455 KC 9/6
Coils S/W 455 KC 9/6
Inters 11/6
Loop aerial coils 9/6
Slug tuned H.F. coils to suit 44 meg. 4/6

GENEMOTORS

Input.	Output.			
24v. 250v. 100mA	.. ..	£1	0	0
24v. 550v. 375mA	.. ..	£2	0	0
24v. 250v. 60mA	.. ..	£1	5	0
12v. 500v. 350mA	.. ..	£8	10	0
12v. 1200v. 200mA	.. ..	£6	10	0
24v. 250v. 100mA.	New	£2	0	0
12v. 235v. 50mA	.. ..	£2	15	0
12v. 350v. 50mA	.. ..	£2	15	0

MINIATURE HI-POWER MOTORS

With Gearbox
100 to 1 reduction, 24v. Reversing. Ideal beam swinging unit.

£2/17/6

TELEPHONES

Standard P.M.G. Type.
Pedestal Magneto Phones. Tested, in perfect order.

£6/10/-

RECORDING TAPE

E.M.I. Hi Coercivity Tape. Ex-A.B.C.

3250ft Platters	.. ..	£2	10	0
2200ft Platters	.. ..	£1	15	0
1200ft Spools	.. ..	£1	7	6
600ft Spools	.. ..		18	6

TRANSCEIVERS

No. 22. Complete with Valves, Power Supply, Mike, Phones, Plugs and Cables.

The addition of Crystals to this set conforms with P.M.G. requirements for small ships, bushfire brigades.

£12/17/6

WANTED

Communications Receivers. Test equipment, P.A. Gear, Large or Small surplus stock. Best prices. Call, write or phone any time.

Oil-filled Condensers

1UF 600V, 6/6 5UF 2.5V 6/6
4UF 750V, 12/6 5UF 400V 6/6
10MFS 500 7.5UF 330V AC 10/-

NEW

American Walky Talky

Wired and Tested.
Chassis, including Aerial and Switch and Circuit. No valves.

19/6 Postage 2/6.

NEW LABORATORY STANDARD AMPMETERS

6in mirror scale. Dual range. A.C., D.C. 0 to 3 0 to 15 amps. In cabinet. Usual price £20.

£3/15/0

NEW 12V Generators

550v. 350mA £8 10 0
250v. 100mA £2 15 0

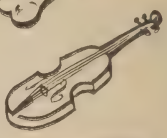
THE EKCO-STYLUS STORY

EKCO

SAPPHIRE AND DIAMOND STYLUS

WOULD YOU USE A

TO PLAY A PRECIOUS



THEN WHY MALTREAT YOUR VALUED RECORDS BY USING CHEAP, IMITATION NEEDLES?

BE "NEEDLE-WISE"—DON'T COMPROMISE INSIST ON EKCO-STYLUS

EKCO-STYLUS sapphire and diamond-tipped radiogram needles are available for every type of pick-up. Your radio dealer will help you to select the type of needle you require for your particular needs.

Ask for our needle chart when making your selection—there is a range of 28 different types.

REMEMBER! The care you exercise to-day in your choice of the world-famous EKCO-STYLUS needle will pay you dividends in the form of longer life for your records and the satisfaction of knowing you are achieving the maximum enjoyment from your discs.

AVAILABLE from all Electrical Retailers and Record Bars throughout Australia.

IF you are unable to obtain supplies of EKCO-STYLUS advise the manufacturers:

ERNEST KUENZLI PTY. LTD.
60 HUNTER STREET
SYDNEY, N.S.W.
BW 6991

HERE'S YOUR ANSWER, TOM!

(Continued from Page 47)

of thinking that the set operates simply because something you did the signal louder. In actual fact, oper way to make the signal louder ply to advance the volume control. would find—or should find—that nd of change you are making has ittle effect on weak signals, simply se the AVC system does not oper- any great extent on weak signals. answer the last part of your ques- adding the resistor would decrease VC bias on the valves, when the as tuned to a strong station. It l not cause any damage, however.

★ ★ ★

I recently built one of your am- iers and while working on it after ing completed it, I noticed that volume increased very noticeably en I shorted the 100 ohm resis- in the cathode of the first valve which point the feedback resis- also connects. Is there some- g wrong with the amplifier.

Tom, there is nothing wrong with amplifier. In fact, it has every in- on of being right. Once again the ess of the amplifier must not be l on its apparent loudness.

len you short out the 100 ohm or in the cathode circuit of the alve, you in fact remove the nega- eedback which in turn increases the ivity and, of course, the volume. wever, the negative feedback has introduced for a purpose. In the f our amplifier it is used to reduce near distortion, extend the fre- y response and lower the effective impedance.

gain these advantages it is neces- o sacrifice some gain. However, usually taken care of in the design oviding an initial gain figure which e suitably decreased by the applica- f feedback to the point where the sensitivity is as required

addition of feedback does not the effective power output and the ouput level may be achieved with ick as without, simply by advanc- e volume control.

LECTIVITY FILTERS

(Continued from page 79)

nodulation difficult to understand. e crowded amateur bands, the num- stations which can be copied clean- ncreased many times compared with umber which can be copied using ormal car radio IF channel which, ntally is about 12 Kc wide at 12 db (Filter 4Kc at minus 12 db). At me of writing, it appears to be more satisfactory to the problem ectivity than Q-multipliers, Q-Fivers me of the other devices which have used in the past.

have yet to try filters at 2.0 Mc. Kc and also to experiment with ds of overcoupling to give a band effect.

study of the long term stability of aterial and the effects of tempera- as not been made but we doubt if will be any difficulties along these Even if the centre frequencies do e slightly with temperature it will of any consequence, provided they drift in the same direction.

LIGHT AMPLIFIER

(Continued from Page 9)

application of a previously unknown phenomenon in cadmium selenide, a photo-conductive material. It was found that under the influence of applied voltage and exposure to light, the conductivity of cadmium selenide will increase sharply and will remain high for long periods after the light source has been cut off.

By using the material as the photoconductive layer in an amplifier panel, it is possible to maintain the flow of current to the electroluminescent layer for long periods after the light source is removed, and to erase the image at any time by interrupting the voltage for a fraction of a second.

The second type of storage panel was described by the development team as an arrangement of photoconductive and electroluminescent materials in tiny cells on a specially fabricated glass plate. In this design, images can be stored by an optical feedback process, using the light emitted by the electroluminescent material to maintain the conductivity of the photoconductive material.

Storage of images by this means is theoretically infinite, although in practice the laboratory devices have been limited to storage of about 15 minutes after extremely brief exposure to the light source.

KEEP OUR FOOD SCIENCE HELPS

(Continued from page 19)

growth of decomposition bacteria.

Salt is a well-known inhibitor of bacterial action. Corned beef is an example, as is also the salting of fish. Acetic acid either neat or in the form of vinegar, is a well-known preservative (as in pickles).

Smoking of meat and fish (usually previously salted) is not wholly a preservative as is commonly thought. The process is used mainly to improve the flavour. However, a certain amount of the by-products of combustion such as formaldehyde acts to some extent in inhibiting the growth of bacteria.

Various chemicals are added to soft drinks and sauces and other condiments to inhibit the growth of bacteria.

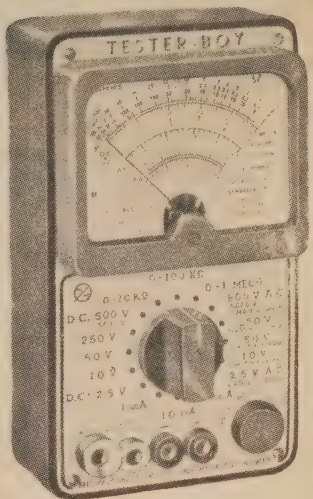
It must be remembered that none of the chemicals used act as disinfectants. They do not necessarily kill bacteria but are merely substances that inhibit their growth and prevent multiplication.

It will be seen therefore that without means of preserving food the human race would be in some difficulty. All food would have to be consumed within a short time of production. This would lead to great dislocation of everyday life. The risks to health would be very great and disease would be widespread.

Early man had no worries of this nature. His whole life was devoted to getting fresh food every day. That is how he did without refrigerators.

"TESTER BOY"

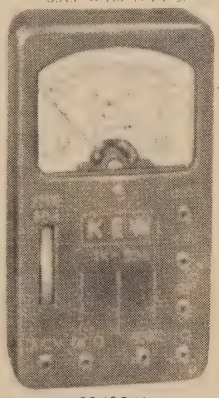
Complete with Leather Case, Test Leads and Batteries



Specifications:
Clear scale 3in x 2in.
Overall dimensions in carrying case 4½in x 6in x 2½in.
1,000 O.P.V. highly damped movement.
Volts: AC and DC.
6 ranges to 5,000 v.
Resistance: 3 ranges to 1 megohm
Current: 3 ranges to 500 mA.
Output: 2 ranges minus 20 to plus 56 db.

Price £7/10/-

Post—N.S.W., 2/3; Q'ld., Vic., Tas., 3/8; S.A., W.A., N.T., 5/-



£3/19/6
Plus Postage 4/-

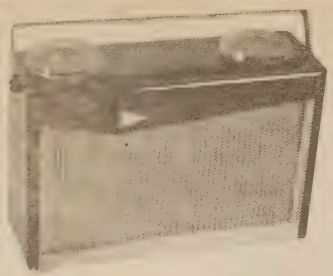
SPECIFICATIONS
A.C. and D.C. Volts: 15/150/750/1000v (1,000 ohms/v)
D.C. Current: 150mA.
Resistance: 100 K-ohm (By 1.5v internal battery)

MAIL ORDERS

Radio House Pty. Ltd.

296 Pitt St., Sydney

***Also available at:* 6 Royal Arcade and 760 George St., Sydney**



MAKING R. & H. TRANSISTOR PORTABLE ?

COMPLETE KIT OF PARTS

£26/10/-

POST EXTRA

SET WIRED AND TESTED £2 EXTRA

INCLUDING 6 S.T.C. TRANSISTORS, R.C.S. COILKIT WITH PRINTED CIRCUITS, ROLA TRANSFORMERS AND 5F SPEAKER & ALL PARTS NECESSARY TO COMPLETE THIS SET INCLUDING ATTRACTIVE & DURABLE TWO-TONE PLASTIC COVERED CABINET.

SPECIAL PURCHASE—HI-FI AT LOW COST

7-VALVE DUAL WAVE HI-FI CHASSIS WITH DUAL SPEAKERS AND LATEST COL LARO 4-SPEED RECORD CHANGER WITH CRYSTAL PICK-UP. THE TWO UNITS

THESE NEW 7-VALVE HI-FI CHASSIS USE THE LATEST PHILIPS 9 PIN VALVES INCLUDING THE DUAL-PURPOSE 6BM8 VALVES IN PUSH-PULL OUTPUT.

WITH EM80 "MAGIC EYE" TUNING INDICATOR, SEPARATE BASS, AND TREBLE CONTROLS, ATTRACTIVE PLATEGLASS DIAL AND SUPPLIED WITH JENSEN M.S.P. DUAL SPEAKERS. 12in WOOFER AND 6in TWEETER.

£39/17/6

F.O.R. Packing 10/- extra.

NEW VALVES AT BARGAIN PRICES

1C4	7/6	EK32	10/6	6H6GT	1/6	6V6GT	17 6
1D4	7/6	6SA7GT	9/6	6K7GT	7/9	VR65A	2 6
1L4	4/6	6SH7	5/6	6U7G	6/6	15	7 6
1T4	10/	1O5G	5/	6J7G	5/	41	7 6
1S5	10/	1P5G	5/	6J6	15/	7193	3 6
3S4	10/	1C7G	5/	6H8G	10/6	954	2 6
3V4	12/6	1K5G	2/6	6A3	15/	955	10
1R5	12/6	6AC7	2/6	7C7	3/6	12A6	10/
1A7GT	9/6	6C8G	7/6	78	7/6	EF50	2 6
1D8GT	9/6	6SS7	8/6	FL32	10/6	110TH	£2 9
6A8G	10/6	6H6	2/6			811	£1
6K8G	9/6					866/866A	15/
6S17GT	6					12SH7	5
6X5GT	10/					6K7G	4/6
12K8						100TH	20/
12SK7	7/6					1C6	7/6

Please add Postage on All Valves
SPECIAL PRICES FOR QUANTITIES

CARBON RESISTORS

New carbon resistors, mixed values. Well-known make.

10/ per 100. Post Free

NEW I.R.C. RESISTORS

I.R.C. new resistors, ½, 1 and 2 watt, in values 50 ohms to 5 megs., including many popular sizes, 51, 151, 201, 251, 501, 1001, 2501, 5001 etc.

(Standard resistor colour code supplied)

100 for 25/-

(Plus 1/6 postage.)

TV I.F. STRIPS

Complete, wired and aligned, supplied with seven miniature valves.

Post extra.

£14/10/-

TURRET-TUNERS £15/-/-

I.F. TRANSFORMERS

Standard I.F. transformers square can (1 3/8) 455K.C. permatuned, 4/3.

(Plus Postage.)

New Micro-Ammeters

New Paton Micro-Ammeters
0-500 mA, 1¾in diameter. Flush mounting.

25/-

Post and Packing, 2/6.

CONDENSER SPECIALS

Boxes of 100 new Ceramic mica paper and electrolytic condensers in values ranging from 50pf mica to 5 400v paper. Values include .0001, .00025, .00075, .01, .02, .05, .1. Also 500 mfd/12v., 10 mfd/440v., 16 mfd/350v., electrolytics.

25/- per 100.

Post Extra: N.S.W. 2 6; Int., 3 6.

MICA CONDENSERS

Standard Mica Condensers, small current types .00003 to .005 including most wanted values.

20/- per 100.
Postage 1/6.

New Power Transformers

60mA prim.: 240v with 230v tapping. Sec. 285 285 with 6.3v filament winding, 60mA.

27/6

Plus Postage: N.S.W.: 3/6; INT., 5/3.

New Midget Power Trans.

40mA Prim. 250v Sec. 225 x 225 with 6.3 Fil. Winding. Upright or Flat Mounting Size 2in x 2½in.

25/-

2/6 Postage. N.S.W.: Interstate. 4 6.

30mA 240v. Prim. 150 x 150v. Sec. with 6.3 Fil. Winding.

22/6

Postage. N.S.W., 2 6; Interstate, 3 6.

Please address all correspondence to 332 Parramatta Road, Stanmore, N.S.W.

METROPOLITAN RADIO SUPPLIES

332 PARRAMATTA ROAD, STANMORE, N.S.W.
640 KING STREET, ST. PETERS, N.S.W.

PHONE LM7398
PHONE LA6087

VALVE SPECIALS! 50,000 New Valves To Clear

12 for	20/-	1P5, 1Q5, 1L4, 1K5, 1C7, 6H6GT, VR65A, 7193, EF50, 954, 955.
8 for	20/-	6SH7, 6AC7, 7C7, 1J6.
6 for	20/-	6C8G, 12SK7, 12SP7.
4 for	20/-	6U7G, 6J7G, 6SS7, 7C5, 2X2/879, 84, 1T4, 41.
3 for	20/-	EK32/VR57, EL32, 6K8G, 6K7GT, 3S4, 1S5, 1R5, 6AG5.

Post & Packing 4/6 extra

ALL VALVES ARE NEW AND MOSTLY IN INDIVIDUAL CARTONS

FOR THAT C.R.O. or TV SET

POST FRAGILE RATE

NEW 5BP1	37/6	NSW 11/- INT. 15/-
902	32/6	NSW 5/- INT 8/-
915	22/6	NSW 2/- INT. 2/6

5BP1 CERAMIC SOCKETS 6/6

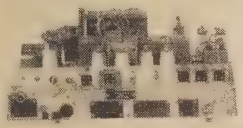
TRANSMITTING VALVES

809	8/6
100 T.H.	8/6
803	25/-

Post Extra

NEW DYNAMIC MICROPHONES
Bakelite hand microphone with switch. 20/. Post 2/6.
Used, but in good condition. 12/6. Post 2/6.
No. 3 CARBON HAND MICROPHONE New. 12/6. Post 2/6.

New American Walkie-Talkie Chassis With 4 piece telescopic AERIAL AND CIRCUIT. Contains basic parts for making small TRANSCEIVER. CHASSIS TYPE 536/511 22/6. Post 2/6.



RADAR RECEIVERS

These radar receivers type ZC955 contain 16 valves and a 30 Mc. I.F. strip suitable for your TV experiment. Units are in new condition.

£2/17/6

Packing 15/- extra.

COMMAND TRANSMITTERS

WITH VALVES AND CRYSTAL

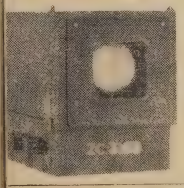
55/-

4 equals 5.3 Mcs., or 5.3 equals 7 Mcs.

MODULATORS WITH VALVES

25/-

Post extra on Command Equipment.

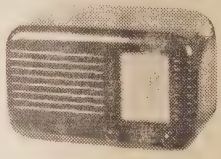


INDICATOR UNITS

These indicator units contain V.R.C. ACR/10 C.R.O. tube and socket. Ideal case for the small scope. (Used, fair condition.)

30/- F.O.R.

MAKE UP THE "LITTLE GENERAL"



£12/17/6

Complete kit of parts for the 1957 "Little General" as featured in R. and H., including attractive bakelite cabinet with slide dial. Price includes valves and Rola 5F Speaker and kit is complete to the last nut and bolt. (Set wired and tested £2/15/ extra.)
Cabinet size 11½in long, 7in high, 6in deep.
Foundation Kit for above comprising Bakelite Cabinet, Chassis and Dial Assembly ... 57/6
Post and Packing: N.S.W., 14/6; Interstate, 25/-.

RADIO ALTIMETER APN.1

These units contain valves, midget genemotor (24v) and Wobulator unit used in the R. and H. sweep and marker generator. Also many other useful parts.

£4/17/-

F.O.R.

PILLO-FONE EXTENSION UNIT

IT'S A REAL MINIATURE WITH ROLA UNIT. Install it anywhere, in the sick room, workshop, garage or any room in the house. Just connect across voice coil of the existing speaker. The 'PILLO-FONE' IS THE MOST CONVENIENT LITTLE UNIT YET DEVISED. 3½in Diameter by 1¾in deep.

POST FREE **22/6**

NEW DYNAMIC HEADPHONES

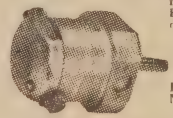
These headphones made by Rola are a high-quality unit giving excellent tone. Fitted with comfortable ear pads.

25/-

Post 4/6.

24 Volt Midget Motors Shunt Wound

Fully Laminated Fields. Wound Armature. Sixteen Segment Commutator, ball bearing. Ideal for Model Trains. Hobbyists, etc. Condition new.



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OM THE SERVICEMAN WHO TELLS

(Continued from page 59)

ut the bucking effect of its neigh-

required only a moment's work to the offending pigtail to its correct inal, whereupon the set came good uncertain manner. Plenty of watts ood clean audio, plus a marked ovement in sensitivity.

xt, I restored the feedback network, to be greeted by a violent burst of iation. Apparently the feedback been positive all the time, the gain e system being so limited by its of operation that it was incapable cillation.

the normal way, I would have y transposed the feedback connec- to the voice coil as being the sim- solution, but this was hardly feas- n this case. The output transfor- was a multiple impedance device g one common lead and a number condary tappings.

ce it was logical to make the com- end of the secondary the "earthy" end, there was not much I could do about phasing the secondary connections. Instead, I had to transpose the primary leads relative to the output plates. As it happened, the two leads were approximately equal in length, but it is as well to keep this point in mind when installing such a transformer, and to check primary polarity before finally trimming the leads.

When the owner came to collect his set he was most impressed with its improved performance, being able to appreciate for the first time just how good a set it was. The only snag was a rather severe "let-down" when he learnt the nature of the fault. This, plus some tactful comments I felt bound to make about his soldering, rather dampened his enthusiasm for the moment. However, it was only temporary, and his enthusiasm had returned by the time he tucked the chassis under his arm and took his leave.

lectricity Without Generators

(Continued from page 7)

ion, pulling electrons off the oxy- ed tubes. These electrons ride on of the solution over to the hydro- ed tubes. There hydrogen atoms with the solution, putting electrons those tubes. This trading of elec- means that electricity flows in the t.

e chemical reaction balances out so nothing happens to the solution in nk, while the hydrogen and oxygen ine to form water (which is then d away in the hydrogen stream).

s simple package delivers plenty of (250 watts per cubic foot of cell, counting fuel tanks) at high effi- (80 per cent). There's no heat or ure. And you can run it on cooking instead of hydrogen) and air (in- of oxygen) if you have to. It , but not as well.

Raising temperature and pressure increases output. This has been done by another company, Patterson, Moos Research, for its Hydrox Unit. Running at 800lb pressure and 464 degrees, it produces three kilowatts from a setup only 28 by 16 by 14 inches — including tanks with fuel for six hours' operation.

Such small cells make good portable power plants, useful for aeroplanes, radar sets, industrial trucks. Big units — the kind utilities need — require very cheap fuel, which means coal or coal gases. This in turn requires very high temperatures (1,000 to 1,800 degrees) and that brings complications. No one is willing to forecast quick success, although top-rank scientists are working on the idea in the U.S. (particularly at Pittsburgh Consolidation Coal Co.), Russia, England and Holland.

Electronic Ignition Analyser

(Continued from page 43)

lead connections are via banana and the power-supply connections through a rear-mounted Jones bar- trip.

aid the builder in interpreting isplays he will obtain, a trouble- ing chart is given in Fig. 8. The cope displays show two conditions n eight-cylinder engine. A few es' use will enable many ignition les to be determined.

is advised that you do not wait trouble develops before using the er, because use on properly ioning systems will develop the arity necessary for proper inter- tion of the displays. Other appli- s will suggest themselves with or instance, feeding the unit with utput of a microphone will aid ding difficult-to-locate engine noises the exact position of the noise dur- e engine cycle is easily determined

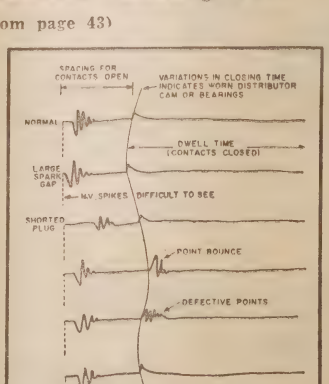

Fig. 8—Trouble shooting chart.

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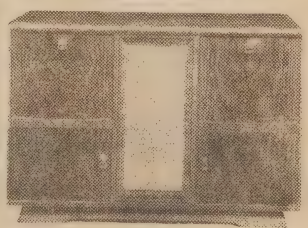

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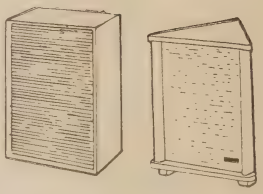

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ANSWERS TO CORRESPONDENTS

(Laverton, Vic.) passes on some informa- garding equivalent valve types. He would e to know when we plan articles on equip- or amateur VHF bands and also SSB. hanks for your observations re. the equiva- the CV66, RL37 and EC54. The answer r query re. further amateur articles is tied h the fact that it is not humanly pos- for our staff to produce full details of s for publication at the rate of one a week ill maintain a reasonable standard. Also erest in television, transistors, etc., is very the moment and we are endeavouring to he greatest number of readers. However fear, the amateur articles have not been en.

L. (Wavell Hts., Qld.) encloses a copy of it from the A.R.R.L. Handbook. He does derstand its operation and would like an ation. The circuit is of a 6C4 cathode fol- driving a 5763 buffer amplifier and is in- to follow a variable frequency oscillator ransmitter.

The circuit you have forwarded is frequent- l to follow a Clapp oscillator. The out- the Clapp oscillator is low and at the ime the frequency stability is improved if pedance of the load imposed by the fol- stage is high. The cathode follower stage an impedance transformer presenting a mpedance to the preceding circuit but a arce impedance as seen by the buffer stage. 63 buffer amplifier operates in class A giv- ther isolation between the oscillator and the ages of the transmitter as well as ampli-

(Edgecliff, N.S.W.) writes to express his ation of the magazine and at the same akes the opportunity to ask a couple of ns.

Your kind words make us feel that our in producing the magazine are worthwhile will continue to do our best to see that ceeding issue is the "best yet." The bush- dio equipment which was described in the ber and December, 1953, issues would be , with minor modifications, for use on the ships frequencies. Copies of the circuits, re available but not the complete maga- The original series on getting your ama- cence appeared in the issues for August, July, 1955, inclusive. The articles on the r examination appeared in the March issue.

B. (Brisbane, Qld.) writes in to ask for t method of record cleaning. D.G.B. also us to settle a controversy regarding the ity of plastic containers scratching records. arly if they are creased. A request on thod for calculating the value of feedback for an alternative value of voice coil and preciative comment on our journal, close 's letter.

We do not know of a best method in clean- crogroove records since there are so many s with their adherents. However, we can end washing your records in detergent en wiping them dry with a soft, lint-free The plastic containers in which records ly come, are far too soft on their own to records, whether smooth or creased. How- any dust or grit which adheres to the could most easily scratch records.

ils on calculating feedback resistor values iven on page 124 of our July, 1958, issue. back number is available from our office if ed it. We thank you for the kind remarks ng our journal.

(Strathfield, N.S.W.) would like to make istorised car radio receiver.

This is a very topical subject. D.K., and e keeping our eyes and ears wide open s developments. While practically all the nents are now available there are still some ns to be solved and we have to be com- certain that a basic design is sound be- ublishing a descriptive article and advising to go ahead with the project. Answering ther query, transistors have a peak volt- ting which must not be exceeded. It is e to operate them efficiently at voltages elow the ratings, but RF transistors par- y should be operated at as high a voltage safe. Since you are not in a desperate we suggest that you watch the magazine ure developments.

P. (Macksville, N.S.W.) asks where he can a set of coils for a modulated oscillator was described in the January, 1954, issue. oils were manufactured for this instrument it was described and some time there- However, this manufacturer is no longer the coils and we cannot suggest another ould be willing to do so. However, in- on given in the article on the adaptation dard IF transformer windings, etc., should you to complete the instrument successfu-

(Clayfield, Qld.) wants to know the cur- ain of the 6AC7 under certain operating ons.

t would be impossible to give the infor- you required without knowing the bias voltage as well. J.C. However, under the conditions you specify, and assuming a bias of —2 volts, the plate current would be 10 mA. At —1.5 volts, it will be 16 mA, and at —1 volt, approximately 21 mA.

C.S.H. (Goulburn, N.S.W.) has built the transistor/crystal set, which was described in the April, 1957, issue of "Radio, Television and Hobbies." Volume in the phones at his home location is so great that he is thinking of trying a speaker. However, he tried the set 30 miles away and found that volume had dropped considerably.

A. The set was only intended to operate headphones, and then with the receiver on a large aerial and close to a station. We do not think that results with a speaker would be good enough to justify the cost, but if you happened to have a sensitive permanent magnet-type speaker on hand with a transformer primary reflecting anything between about 1,000 and 10,000 ohms, you could try it for the sake of experiment. The higher values would result in higher gain, but the power output would be very low and vice versa. There is little which can be done to improve the station pickup of such a simple receiver. The next improvement we could suggest would be the regerative transistor receiver described in the June, 1957, issue, and, following that, the version with the audio amplifier stage described in the July, 1957, issue.

R.A.C. (Burwood, Vic.) asks whether there was any error in the power supply circuit for the 57 Portable receiver in the December, 1956, issue.

A. You are quite correct in your supposition, R.A.C. The 330 ohm 1w. and 2,00 ohm 10w. resistors should be transposed, the latter supplying the filament circuit.

L.S. (Bentleigh, Vic.) wishes to use a power transformer as a vibrator transformer, the normal filament winding serving as a primary and the 240-volt winding as a secondary. The idea is to power a small mains-operated radio from a 6V car battery.

A. Unless you have an oscilloscope and an accurate voltmeter, the scheme is not likely to be very practical from your point of view. In order to minimise sparking at the vibrator contacts, an appropriate buffer capacitor should be connected across the primary or the secondary of the transformer or both. Without the instruments, the optimum value for this capacitor would be difficult to determine. Further, the voltage delivered by the arrangement would be less than 240V RMS AC, and it is unlikely that a sufficient range of tappings to obtain the required voltage would be available. Circuits to suppress vibrator interference in the receiver would probably be necessary also. We have published circuits of a number of small transmitters at various times and if you care to give us further details it is possible that we could help you through the 2/ query service. No doubt you are aware of the need for a P.M.G. licence before a transmitter of any sort can be operated legally.

C.R. (Naremheen, W.A.) writes to say that there is no power available in his locality and that he wishes to see more dry battery and vibrator operated receivers. C.R. also wishes to know if a transformer is necessary in a vibrator supply. He ends the letter with an appreciative comment on our journal.

A. In recent years we have described a large number of sets of the type you mention. With the advent of transistors, however, sets of that type will become obsolete and our time would be better spent in the development of receivers using transistors.

A transformer is necessary in a vibrator power supply but, unfortunately, in the limited space available we could not do justice to an explanation of the reasons involved. We feel that this query would be more suitable for the Answer Tom page and we shall file it for future use on that page.

We thank you for the appreciative comment

J.B. (Warragamba, N.S.W.) points out a couple of errors in the diagrams for the transistor/crystal set which appeared in the April 1957 issue. The two circuits on page 23 were transposed and the battery polarity in the case of the circuit on page 31 was incorrect.

A. You are perfectly correct J.B., but fortunately the information given in the text made the errors very clear. Two transistor receivers which may be of interest to you appeared in the June and July, 1957 issue. The use of an RF transistor allows regeneration which results in much improved sensitivity and selectivity.

G.P. (Ayr, Nth. Qld.) says he has been keeping a look out for VHF DX, using a 21in commercial TV receiver. Recently, with the audio system cross-connected to the video detector, he heard a Japanese amateur station calling on his Channel 1 setting. Loudest signals came in with the aerial pointed due south and elevated 30 degrees.

A. Japanese amateur stations are being heard over long distances during summer months on the 6 metre band, though the direction of reception is unusual. Offhand we cannot supply the address or JA1-BTC but someone else may be able to oblige. (G. Peturen, Box 568 Ayr, Qld.).

D.H. (Ulverstone, Tas.) writes to tell us of the excellent results he has had with a single transistor receiver which was described in the June, 1957 issue of Radio, Television and Hobbies. He recently logged HCJV, Voice of the Andes, Quito, Ecuador, S.A.

A. The results you describe are certainly amazing, D.H., and we certainly would not expect that you could receive stations from such a distance on so simple a receiver. Good luck with future projects. We hope to be able to publish much more on transistors and transistor receivers before too long.

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Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three constructional projects. Scale blueprints showing the position of all holes and cut-outs in standard chassis can be supplied for 5/-. These are available for nearly all our designs but please note they do NOT show wiring details.

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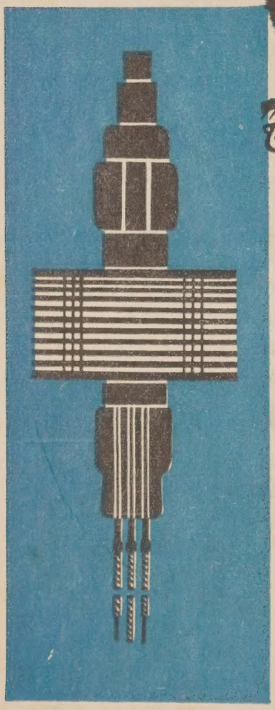
Today the sounds of man-made flight are a commonplace thing, and with ever increasing air power has come ever increasing responsibility to the thousands of passengers and air crew members who travel the airways daily.

The responsibility for maintaining strict air schedules and maximum safety during arrivals and departure at the various air terminals throughout the world, is largely handled by means of radio. Without radio many of the safety devices used daily at these air terminals would not exist.

Radio plays a major part in today's air travel, and the Australian valve most used in air to ground communication, is, of course, Radiotron.



CHOOSE RADIOTRON

RADIOTRON 5786
Used in Aviation
Distance Measuring Equipment.

Manufactured by

AMALGAMATED WIRELESS VALVE CO. PTY. LTD.

A SIMPLE RECEIVER FROM THE JUNK BOX

(Continued from Page 53)

re sion as the tuned winding and, if l e turns cannot be accommodated n e former in the one layer, there is othg wrong in winding it in two or er three layers.

It may be easier to extend the former. s did. The extension piece was a gh fit over the end of the former and as emented into place.

Most coils are designed to work with en but, you may please yourself he er you use a can or not. The re- ov of the can will increase the in- ce of the coil and tend to crowd e ations at the high frequency end e band. To compensate for this ea you may remove the trimmer from e ing section in use. However, if you sh to align the set to use with an ex g dial it would be desirable to fit e in and retain the trimmer.

C. MOUNTING

In preference, the coil should be ou ted over an octal hole in the ass, it is then a simple matter to run ad to the various components.

Fo connections only are required de the chassis. The common earth nection goes to a convenient earth int near the valve socket and the top d of the aerial winding goes to the ri terminal, which may be seen under e eaction capacitor. Connection to e op of the tuned winding is made ov the chassis with the aid of a tag in which also supports the 1 meg. grid lk and its 100 pf capacitor.

Connection to the reaction winding is ad under the chassis. The lower end th winding goes to the plate of the te or while the upper end goes to the rd of the reaction capacitor.

REACTION CAPACITOR: This is a na variable unit of about 100 pf pa tance. As this capacitor has to e ntrolled separately it will not be ssible to use the second section of a o ction tuning capacitor. The ajority of sets likely to be used for our rpose did not contain this item and it ay be necessary to purchase it.

TUNING CAPACITOR AND DIAL. is usually possible to salvage a two or re gang tuning capacitor in reason- ly good condition. The gang should e amined for bent plates and corro- on the insulators supporting the e plates. Only one section needs to in good order.

Values of tuning capacitors may vary t is is not critical, provided the value in the vicinity of 400 pf.

TUNING DIAL

If the dial has station callsigns or Kc ar ing on it, it should ideally be match- to the gang. On the other hand, it ou d be possible to calibrate a suitable ra nd attach this over the old calibra- on as was done in our case.

Having completed the mechanical wo and the electrical wiring, it now re- ain to switch the set on and coax it in.

The set should be switched on without th valves at first, just in case. If there ar sign of smell or smoke, or the ar ransformer getting hot, it should im- ed tely be disconnected, and the wir- ing rechecked for errors. If the trans- former still shows signs of distress, then it should be discarded.

If all is well, the loudspeaker may be plugged in and the tests carried a step further.

At this stage the detector and output valves should also be plugged in and if the heaters light up normally you can plug in the rectifier as well. As soon as the filament of the rectifier lights up, there should be some sound from the speaker.

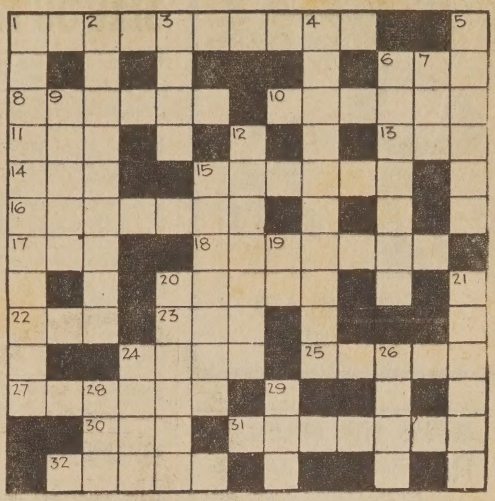
Attach a few feet of aerial to the set and it should be possible to tune in a station with the reaction capacitor plates about half way in mesh. If the station is weak try advancing the reaction a bit until it is just below the point of oscillation. This will increase the volume and selectivity.

If the set should refuse to oscillate, even with the reaction capacitor fully meshed, try reversing the connections to the reaction winding. If this does not help revert to the original condition try adding some turns to the reaction winding until the set goes into oscillation with the reaction capacitor plates

Similarly, if the reaction cannot be controlled remove turns from the reaction winding or space it further from the tuned winding.

In closing, we will give you a little warning: Once it has been established that the set is capable of oscillation, it should not be allowed to oscillate indiscriminately. Besides causing severe distortion from the speaker, it will be a source of annoyance to neighbours.

THE R., T.V. & H. CROSSWORD No. 55



ACROSS

1. Beyond zone of good TV coverage (2 words)
6. To do wrong
8. Large bird of prey
10. Used for wiring
11. Used for golfing
13. Single
14. A cover
15. Kilowatt hour
16. Transposition of letters of word
17. Man (pl.)
18. A matter o fact
20. Body of men
22. First woman
23. Moslem name
24. Musical composition
25. Narrow pieces of fabric
27. Marks left by anything passing
30. Steamer (abbrev.)
31. Trigonometrical ratios
32. Preterit of choose

DOWN

1. Unit of brightness (2 words)
2. Apparent resistance
3. A shade
4. To similar specifications
5. To bring to a stand
6. Rubber vulcanised with sulphur
7. Preterit of run
9. River in France
12. Greek God of justice
15. Electronic light valve
19. Similar to
20. Sheets of legal documents
21. To oppose
24. Prefix meaning eight
26. Liquid measure
28. Left after burning
29. Not lofty

Solution and further crossword next month

Last month's solution

B	U	F	F	E	R		S		P	U	S	H		
A		O	U	R		G	A	L	E	S		E		
N	O	I	S	E	F	I	G	U	R	E		A		
D		L	E		I	G	O	R				T		
W			B	E	L	L		I	M	A	G	E		
I	S	O	L	A	T	I	O	N		B		R		
D		W	O	R	E		A	G	R	A		B		
T	A	L	C		R	A	T			T	R	I		
H			K		C			A		T		A		
	A				H	E	A	D	S	E	T	S		
I	N	D	I	G	O		F	A	I	R	Y			
C	O	O			K		A		D	Y	N	E		
E	N	G	I	N	E	E	R		E		E			

Printed and published by Sungravure Ltd., at the registered office, 21-29 Morley Avenue, Rosebery, N.S.W.

AWA RONETTE

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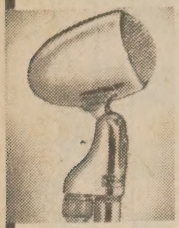

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FOR SALE: 17in TV set. French cabinet, Polaroid safety glass, £90 or best offer. **1359 Pacific H'way, Turramurra. JJ4424.**

WANTED: B.C.-348 repair manual. **30 Buchanan Street, Hamilton, Newcastle, N.S.W.**

WANTED Red Line AF15 or Ferguson OP25. 15 ohm v.c. Price and condition to. **Olding, 82 Farrant Street, Prospect, S. Australia.**

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SELL: 1155A Comm. receiver 70kc-18.5mc, 5 bands switched. Inc. b'cast. 8 tubes, high gain. Perfect order. Complete with P. pack and matched spkr. phones, £15. **A. Shaw, c/- P.O. South Brisbane.**

SELL: H. duty power pack 1000v at 250 ma. 240 vac. impt. perfect £12/10/-, also some UHF gear, var. conds., tubes also 80-5mx field strength meter and phone monitor. £2/10/-. **A. Shaw, c/o P.O. South Brisbane.**

SELL: 1155 Rec. conv. AC. Q plus I.F. strip Astor TV chassis wired. Receiver Nat. H.R.D. 6 coils G.C. and B.S. .5-30mc. **35 Reading Road, Brighton, Sydney.**

SELL: Tape Recorder Grundig TK5 with mike, new condition. **Melbourne, BM5039.**

WANTED: AR88D or equivalent receiver—price, details to **J. Thompson, 20 Alexandra Ave., Rose Park, S.A.**

3 DIMENSIONAL TV SYSTEM

(Continued on Page 27)

not required, two RCA "TV-Eye" cameras and control units can be substituted for the ITV-6 units at a substantial saving in cost.

General Considerations

An interesting fact observed in the operation of these three-dimensional television systems is that the two cameras need not have identical transfer characteristics to provide good stereoscopic viewing. It is not necessary, therefore, that the cameras be specially selected or matched. It was also found that vertical displacements of as much as 1/8 inch between the red and green image fields of the 21CYP22 were not detectable through the viewing glasses.

—Radio and TV News

ANSWERS TO CORRESPONDENTS

J.D.A. (Kurri, N.S.W.) wants to know whether we have ever described an electric welder for 240v operation.

A. Sorry J.D.A., but we have never described anything along these lines and, in fact, we feel that it is a project which might present a number of problems for the home constructor, particularly in regard to the supply of suitable materials. In many cases, the final cost may be nearly as high as that of a commercial unit.

P.G. (Torrensville, S.A.) writes in to say that he is a beginner in radio. His activities have included the construcion of a few small sets and a four valve amplifier. P.G. has also acquired a multimeter, soldering iron etc. Having achieved this much, he now wishes to contact and possibly correspond with an experimenter who has reached a similar standard, in order to exchange ideas.

A. P.G.'s idea is an excellent one and, for any one wishing to contact him, the address is as follows: Philip Gordon, 7 Rawlings Ave, Torrensville, S.A.

A.J.N. (Moorooka, Q.) writes to express his appreciation of the Transport articles, both practical and theoretical. He also makes a number of suggestions concerning articles he would like to see involving the use of transistors. These include the transistorisation of many pieces of test equipment, audio circuitry, etc., plus the idea of converting existing valve portable for transistor operation, salvaging as much as possible of the major components.

A. Many thanks for your comment A.J.N., particularly regarding the Transporta articles, which called for a lot of effort on the part of the staff member concerned. We fully appreciate the possibilities of transistors in the manner you suggest, the main snag being to know where to start and to find time for all these projects. Eventually, we hope to cover as wide a field as we now do with valves, but much of it will have to wait until time and suitable components are available. The idea of re-vamping existing portables might have some merit, and we will keep this idea in mind. Much would depend on the original design and how much the owner was prepared to scrap in the way of valves, coils etc.

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